RESOURCE MANAGEMENT AND THE TRANSITION TO A STEADY STATE

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ABSTRACT

The purpose of this study is to examine some characteristics of the transition to a steady state and its implications for Resource Management.

The transition means changing from a society based on exponential growth in population and resource consumption to a 'post-industrial' economy with a low rate of throughput and recycling of energy-matter. More importantly, it means a fundamental change in the world view or paradigm guiding the interaction of society with its environment. Such a change represents a cybernetic adjustment in the human system - an alteration of behaviour in the light of information fed back from its environment. During evolutionary history, such adjustments have enabled other species to adapt to change in their surroundings and to survive.

The study analyses the emergence of a new world view using the concept of paradigm shift from Kuhn (1962). It is argued that the 'anomaly' of the environmental crisis has led to a questioning of fundamental assumptions about growth and progress and the control of Nature, which underly industrial culture.

The major characteristics of the prevailing Technocratic paradigm are contrasted with some of the discernible characteristics of an emergent Organic paradigm. The conflict between these two world views is treated as a dialectic process - leading to the reconciliation or synthesis of opposing trends.

It is suggested that Resource Management exhibits many attributes of the dominant social paradigm but that trends within it reflect the same struggle of world views developing in wider industrial society.

CONTENTS

INTRODUCTION

This study looks at the response within industrial society to the global environmental crisis of pollution, resource depletion and over-population. It is suggested that this response has developed through several levels of awareness - from seeing the crisis as a problem in the 'environment' which has to be controlled, to a level where the crisis is perceived not in terms of its physical symptoms, but rather as a Krisis or turning point in fundamental human values and attitudes toward Nature.

The study is divided into three parts. In Part I, an introductory chapter traces the progression of conceptual responses to the environmental crisis and concludes that it can now be seen at two levels - as a physical problem related to the excessive use of energy in industrial society and as an ethical problem arising from Man's urge to control Nature.

Chapter Two is based on the work of the Club of Rome and discusses the ecological consequences of exponential growth in the resource demand of the human system and the natural processes controlling growth. It is suggested that industrial society can either continue to expand its ecological demand and incur harsh biological controls or choose a deliberate transition to a steady state.

In Chapter Three this adjustment to the limits of a finite world is treated as a cybernetic response, i.e. a change in the behaviour or form of the human system in the light of information fed back to it from its environment. The depletion of the temporary fossil fuel energy base of industrial society is generating new information and can be related to the emergence of a post-industrial world view which may prove more appropriate for human survival.

In Part Two the transition to a new world-view is treated as a 'paradigm shift', using the concepts of T.S. Kuhn in his *Structure of Scientific Revolutions* (1962).

In Chapter Four this concept is extended to social paradigms, which can be seen to determine the adaptivity of a culture to its surroundings.

Chapter Five discusses some of the major characteristics of the Technocratic Paradigm which has guided the growth of industrial society. An historical overview is made of Western concepts of progress and knowledge and it is suggested that these attitudes have occurred within a distinctively masculine philosophy which has mythed Nature as feminine and therefore separate and inferior to the ordered world of Culture.

In contrast to this view, Chapter Six describes some of the discernible characteristics of an emergent Organic Paradigm which rejects the values of growth and the ordering of Nature in favour of values which emphasise

humility and the importance of personal fulfilment over material accumulation. A more feminine cosmology recognises the cyclicity of life processes and thus seeks to reconcile the means of human existence with its purpose or ends.

This kind of world view (and the language in which it is expressed) is likely to be rejected and resisted by the adherents to the Technocratic paradigm. A struggle of world views is occurring which can be seen as a dialectic process whereby the contradictions within the prevailing thesis of growth and progress have matured in the form of environmental and social breakdown.

Chapter Seven concludes that a synthesis may be found in a holistic world view which requires the presence of both masculine and feminine principles - within the individual person and in the interaction between people and nature.

Finally, in Part Three it is suggested that the same struggle of world views may be found within the discipline of Resource Management. Trends towards increasing control of Nature as an 'environmental problem' are contrasted with a more holistic world view, based on ecological rather than economic approaches. It is concluded, however, that ecological insights can be used either to develop a centrally controlled Maximum Feasible steady state or, in contrast, may lead to a Frugal society which recognizes the limits of human knowledge and emphasises lower energy use and humility toward Nature.

The theme of the study concerns the reconciliation of opposites and thus it seeks to integrate concepts from both biophysical and social science. As such, the study breaks across long established disciplinary boundaries and can not be fixed neatly within any one 'theoretical box'.

For the author, this has meant traversing several new regions of knowledge, and it is inevitable that in some places she may not have made a perfect translation of the 'local language'.

Nevertheless, the journey is an important one for it offers a new image of reality based on a synthesis of conventional knowledge rather than a reduction of observable phenomena within the bounds of a single discipline.

From this perspective it is possible to stand back from the 'environmental crisis' and to consider the connections which flow between the physical dilemma of industrial culture and the way it organizes its conceptual response to that situation.

Resource Management - as one kind of conceptual response - can be placed within a wider pattern of evolutionary change in which the human system may resolve its crisis of world view as it begins its physical transition to a steady state.

PART I THE TRANSITION TO A STEADY STATE

THE ENVIRONMENTAL CRISIS

1) INTRODUCTION

2) LEVELS OF AWARENESS

3) A CRISIS OF INDUSTRIALISM

4) AN ENTROPY CRISIS

5) A CRISIS OF HUMAN VALUES

6) CONCLUSION

THE ENVIRONMENTAL CRISIS

1) INTRODUCTION

Today, when only a third of humanity has entered the 'technological age' (1) the world is faced by a global crisis of pollution, resource depletion and over population.

In their book *Only One Earth,* Ward and Dubos describe the deteriorating state of the human environment:

> "Rivers have caught fire and burnt their bridges. Lakes and inland seas - the Baltic, the Mediterranean - are under threat from untreated wastes .... The burning of fossil fuels is increasing with unforeseen consequences for the earth's climate and atmosphere .... Even the vast oceans, covering 70 percent of the globe and providing an apparently inexhaustible reserve of moisture, an endless dump for wastes and a perpetual source of freshening winds and currents, are far more vulnerable to man's polluting activities than has been assumed." (2)

This chapter traces the progression of conceptual responses to the environmental crisis, particularly since the 1960s. The global crisis is a very recent event in human history and is now increasingly regarded as a result of the excessive rate of energy use (resource conversion) in industrial societies, both capitalist and socialist alike. A number of writers have come to define it in thermodynamic terms as an entropy crisis and many conclude that this stems primarily from a crisis in human values.

2) LEVELS OF AWARENESS

Environmental problems have come to receive a great deal of attention, particularly since the 1960s (3), the decade

which saw the first man land on the moon and ended with the celebration of Earth Day. As Barry Commoner wrote in 1971, "The environment has just been re-discovered by the people who live in it". After what was a sudden and noisy awakening "everyone seemed to be aroused to the environmental danger and eager to do something about it." (4). Illich (1973) commented:

> "The precarious balance between man and the biosphere has been recognised and has suddenly begun to worry many people. The degradation of the environment is now dramatic and highly visible." (5).

By 1977, the authors of *Ecoscience* concluded:

> "The significance of environmental deterioration is inescapable .... That civilization has entered a period of grave crisis is now doubted only by those afflicted with incurable Micawberism. Everyone who is alertable is alerted."

Alarm over the state of the environment produced a new generation of prophets warning that ecological disaster was imminent and that the human race was doomed (6). At the other extreme, the 'technological optimists' claimed that modern society was about to enter a new golden age of expansion (7). The energy crisis would be solved with nuclear power, new resources would be synthesised in the laboratory and the world's exploding population could soon be resettled on colonies in space (8). The majority of economists believed (and continue to believe) that pollution would be cleaned up with higher rates of economic growth and that the problems of the Third World would disappear once they were assisted to the crucial "take-off" stage of industrialization (9).

The diversity of explanations and prognostications which has emerged is a reflection of fundamentally different levels of understanding of the nature of the environmental crisis[1].

Initially it was perceived merely in terms of its symptoms, such as the pollution of rivers, oil spills, eutrophying lakes and the visual ugliness of industry. The response was either to ignore the problem, screen off the unpleasant views or leave the solution 'to dilution'.

However, once it was recognised that pollution was affecting human welfare, it took on a new urgency. Rachel Carson's *Silent Spring* aroused the public to the threat of pesticides in the food chain. New pollution regulations were passed and contaminated water had to be treated, effluents lowered and filters were placed on factory chimneys.

The loss of 'natural services' such as soil fertility, clean air and fresh water began to reflect in economic costs. By the 1970s, the depletion of resources began to affect the well-being of industrial economies. The 'Energy Crisis' generated rapid inflation and a sudden new awareness of the vulnerability of fossil fuel supplies. Conservation became a 'household word' but not necessarily an economic reality. The response of the industrial nations has been to increase the domestic production of oil and oil substitutes, and to

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1. See Knelman (1978) for a similar progression of conceptual responses.

expand their military and political influence in the Middle East and other regions with significant mineral deposits.

Although the Western nations had begun to accept the concept of limiting population growth, economic growth continued to be the primary social goal. The response to resource shortages was to increase investment and exploration to promote higher production.

However, by the end of the 1970s many people had begun to realize that even if environmental symptoms like pollution could be regulated, continued high rates of resource consumption would still lead to the loss of wildlife habitats and the dislocation of ecosystems. It was now recognized that the frontiers of human expansion had closed. In a finite world, continued growth in the human system was only possible by diverting the energy and resources of other sub-systems in the biosphere, thereby destroying the life-support systems on which humans depended.

Today, environmental awareness can no longer be defined as some eccentric concern for 'the birds and the bees' or a romantic desire to 'get back to Nature'. There is now a clear understanding that the excessive growth of the human system is a threat to human survival and potentially a threat to all life on the planet. Lewis Mumford has said:

> "The present danger is not just that a rare wild species or some precious natural feature may be obliterated .... The great threat is to man's own existence" (10).

G. Evelyn Hutchinson states that "many people are concluding ... on the basis of mounting and reasonably objective

evidence, that the life of the biosphere as an inhabitable region for organisms is to be measured in decades rather than hundreds of millions of years. This is entirely the fault of our own species" (11).

The environmental crisis can no longer be perceived as a problem in the environment; it is a fundamentally human problem.

3) A CRISIS OF INDUSTRIALISM

The global environmental crisis is a very recent event in the two million year history of human development.

Miller (1975) explains that of all the human beings who have ever lived, 90 percent have been hunter-gatherers, only 6 percent have lived by agriculture and only a few percent have lived as industrial men and women. "Yet these few percent, within slightly more than 100 years, have led us to the global environmental crisis of today" (12).

The activities of early humans undoubtedly produced many small ecological imbalances but in the long run these limited and controlled human numbers, creating a new equilibrium (13). The advanced hunter-gatherers had a greater effect on the environment. They are known to have slaughtered herds of animals which may have contributed to the extinction of some species (14). However, because of small numbers, their impact was still insignificant on a global or even a regional scale (13).

The rise of agriculture saw the destructive alteration of land throughout much of the world (15). Agriculture led to the simplification of ecological communities as forests were replaced by grasslands. The burning and clearing of forests by early agriculturalists caused climatic change and soil erosion.

The production of a food surplus and the growth of human settlements led to increased human domination of the environment. Diverse forests and other habitats were replaced by millions of acres of monocultural crops. The spread of human settlements across the earth saw the alteration and destruction of the habitats of innumerable species, many now extinct or endangered, the emergence of pests and diseases and the pollution of waterways with eroded top soil (16).

But the industrial age has brought quite new ecological problems: air, water and solid waste pollution, large-scale mining, the chemical poisoning of ecosystems and the production of radioactive wastes. While early societies did alter local ecosystems, the twentieth century industrial society has become a threat to the biosphere as a whole (17).

> "Our sudden and vast accelerations - in numbers, in the use of energy and new materials, in urbanization, in consumptive ideals, in consequent pollution - have set technological man on a course which could alter dangerously, and perhaps irreversibly, the natural systems of his planet [sic] on which his biological survival depends". (18).

Human society has come to dominate the global biotic community but human dominance is beginning to

have self-destructive consequences. Because the human habitat now encompasses the entire planet, if we 'foul our own nest' we endanger the whole world (19).

A number of writers (20) have come to blame the environmental crisis on capitalism, but in fact it affects both capitalist and socialist systems alike. For example, Goldman (1970) writes that any 'depressing story' about pollution in the United States can be matched by a 'horror story' from the USSR. He cites incidents of fish kills in rivers and lakes, water pollution from factories, mines and ships, air pollution problems in most Soviet cities, coastal erosion and the disruption of hydrological systems by irrigation. Like other industrial countries, the Soviet Union has to contend with increasing population growth, particularly in urban areas. This is associated with an increase in the quantity and complexity of production and a strong emphasis on economic growth. Goldman concludes that "if the study of environmental disruption in the Soviet Union demonstrates anything, it shows that not private enterprise but industrialization is the primary cause .... The replacement of private greed by public greed is not much of an improvement" (21).

As we have seen, however, environmental problems are not restricted only to the industrial countries - the crisis is inherently global in scale. Yet, global signals of environmental deterioration are appearing on the human horizon with a world population of less than 4 billion, "half

of whom have hardly raised their claims on the planet above those of neolithic man" (22).

It is becoming apparent that the growing dysfunctions in societies all around the world are caused by the activities of a few 'overdeveloped' nations (23). The Western nations, plus Japan and the USSR, account for only a quarter of the world's population but use 80 to 90% of its resources. The USA, for example, has less than 6% of the world's population, but uses a third of its resources and produces almost half of the world's pollution (24).

The historical expansion of the developed world depended on 'taking over' the resources of other countries (25). This expansion has frequently been achieved by displacing traditional cultures (26) and damaging the ecosystems on which they were dependent.

Today, the developing nations are demanding a greater share of the world's wealth and political power and are intent on rapid industrialization in the hope of achieving it. Ironically, this drive for modernization has begun at the same time as the developed nations are confronted with worsening resource shortages and economic recession.

The tragedy of the global expansion of industrialism is that it is physically impossible, on this finite planet, for all the people of the world to have the same standard of living as the average American (22). Miller (1975) explains that if the present level and pattern of American industrialization and energy use were extended throughout the world, within a short time the planet would be

uninhabitable[2]. Daly (1980) terms this the 'impossibility theorem'. He maintains that it is not possible to support an ever-growing standard of per capita consumption for an ever-growing population. Development plans which take this as their goal, as most development plans do, are "simply unrealistic" (27).

With the development of industrial society the simple Malthusian dilemma of a geometric increase in human numbers against an arithmetic rate of food supply has been compounded by 'neo-Malthusian' over population: the exponential growth of energy and resource consumption (and consequent pollution) *per capita* against a finite physical base (28).

How has industrialization led to neo-Malthusian over population?

As Cottrell (1955) has shown, the history of human development is basically the history of increasing the use of energy. While primitive people depended entirely on muscle power, later cultures supplemented human energy with animal, wind and water energy.

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2. Miller writes: "The atmosphere would contain 200 times more sulphur dioxide, and 750 times more carbon monoxide and carbon dioxide than it now does. Our lakes, rivers and oceans would be loaded with 175 times more chemical wastes than at present and thermal pollution would completely disrupt our aquatic ecosystems. Two-thirds of the world's forests would be eliminated and each year 30 million acres of farmland would be converted into cities and highways. The earth's supplies of fossil fuels, minerals and uranium would be depleted within a very short time." (29).

Industrial society made a "quantum leap" by discovering how to unlock the chemical energy stored in coal, oil and natural gas and to extract ores from the earth (16). Each increase in the energy available to human society has enabled it to increase the number of people to be supported by its environment. Catton (1980) writes that the use of fossil fuels with industrialization has led to "a conspicuous and unprecedently large acceleration" of population growth (30). Increasing the energy supply has not only led to an increase in human numbers, it has increased the energy consumption of each individual.

However, this most recent expansion of human population has only been possible by 'drawing down' the earth's stock of fossil fuels, a strictly finite reservoir of solar energy captured by photosynthesising plants and buried underground millions of years ago. Obviously this limited and depletable fund could provide only a temporary supply of energy for industrial society. As Catton explains, "this begged one enormously important question: What happens if population, as usual, increases until it nearly fills this temporarily expanded set of opportunities and then, because the expansion was only temporary, the world finds itself ... with a population excess?" (31).

By consuming the earth's finite stock of 'capital' resources, rather than living within the flow of biological 'income', industrial society has been committed to living on a scale that exceeds the energy supply of its environment.

Daly (1977) writes that "since man (sic) is the only species living beyond the solar budget, it is clear that such behaviour will throw the human species out of balance with the rest of the biosphere. ... It is only natural that this unique expansionary behaviour should cause repercussions and feedbacks from the rest of the system in the unhappy form of pollution and breakdown of local life-support systems"(

Thus, the global environment crisis of depletion, pollution and over population, stems primarily from the excessive use of energy by industrial society. Illich (1973) makes the point that it is not a crisis within industrial society, but a crisis of the industrial mode of production itself:

> "Every social system, like those in nature has certain characteristic parameters of distance, time periods, populations, energy sources and energy sinks. When the activity of the society goes beyond these natural scales, dysfunction occurs" (33).

Illich considers that the present industrial system is organized for indefinite expansion and is inherently unstable. He concludes that the corporate scale of industrial activity (whether privately or publicly owned) threatens to overwhelm society and threatens the physical structure of the environment with which the human species has evolved.

4) AN ENTROPY CRISIS

A number of other writers (34) have come to understand the environmental crisis in thermodynamic terms as a result of the excessive rate of energy use or resource conversion in industrial society.

Because the earth's supplies of fossil fuels are limited, continued 'mining' of terrestrial energy stocks (and of other non-renewable resources) is causing depletion. At the same time, because the earth's capacity to assimilate wastes is limited, continued resource conversion is causing pollution. The high rate of energy use in the human system exceeds the levels of energy flow of its environment and has resulted in degradation and disorder throughout the rest of the biosphere. From this perspective, the environmental crisis is merely the signal of a global entropy crisis - the inevitable result of human attempts to violate fundamental physical laws governing the behaviour of every system in the biosphere, the Laws of Thermodynamics.

The First Law of Thermodynamics states that energy-matter cannot be created or destroyed but can be transformed from one form to another. The Second Law of Thermodynamics states that closed systems tend spontaneously toward disorder or entropy. Order inside any system can only be maintained by inputs of available energy (neg-entropy) but this is possible only with a greater increase in disorder in the surrounding environment. Thus no conversion of energy can ever be 100 percent efficient - waste is always produced, which occurs as heat or the chaotic motion of molecules.

In this sense it can be seen that resources cannot be 'produced' or 'consumed' but merely converted from one arrangement to another. The conversion of energy-matter produces entropy,which is a measure of energy unavailable to do work.

The biosphere can be defined as a dynamic steady-state system which is closed for matter but open for energy. Earth's primary source of energy is the sun.

The biosphere derives its structure from a global balance of incoming (available) energy and outflowing (unavailable) solar energy (Ehlich *et al.*, 1977). The earth receives limited income of solar energy and all energy flowing into the system must equal energy flowing out. Thus, within the boundary of the system at any one time there is a limited energy stock which is distributed across the complex of ecosystems which make up the biosphere. Ophuls (1977) notes that "energy is the currency of nature's economy; the biomass and stock of materials are its inventory or capital". Only a small portion of the energy reaching earth is captured by photosynthesising plants. Thereafter the network of food chains, on which human beings and other organisms are dependent, is structured by different energy stores at each trophic level.

There is an energy balance which gives form to all sub-systems as well as for the biosphere as a whole. For example, living organisms can be regarded as pools of accumulated energy, which will dissipate into disorder when they die. The work of accumulating dispersed energy into an ordered living form requires energy and, for the organism to live, it must transform energy from its surroundings. Both these processes produce waste or entropy. However, in the balanced system of the biosphere, this disorder is

countered by the next incoming flow of energy from the sun. Thus there is an equilibrating relationship between an organism and its environment.

Ecosystems are also structured by a dynamically balanced relationship, based on their utilization of global energy flow.

Energy accumulates and disperses from all systems at a given rate. For example, as plants live (and when they die), their components become available to other organisms or subsystems according to the rate at which they are degraded. Given earth's limited solar income, energy use in any subsystem is both dependent upon and responsible for the pattern of available energy across the rest of the biosphere. Because matter is essentially a temporary stock of accumulated energy, it can be said that "everything is connected to everything else". According to Ward and Dubos (1972) "matter and energy are simply different aspects of the same fundamental reality and in all their manifestations obey the same ineluctable cosmic laws". Furthermore, "the operation of these laws through all the infinite varieties of material things and energies" generates a basic unity in the biosphere, a "dynamic equilibrium of biological forces held in position by checks and balances of the most delicate sort"(35).

Thus, life on the planet is possible because within the biosphere negentropy and entropy are in a state of dynamic balance, which produces a continual tension between the forces of order and disorder.

The complex energy flows and energy pools (matter) of the biosphere have been developed over evolutionary time to a complex and intricately structured system.

All the species of the biosphere are adapted to living within the fixed income of solar energy, but, as Daly (1977) points out, in the last two centuries (a mere instant in the history of the biosphere) the human species has ceased to live within the solar budget and has become addicted to living off low-entropy stocks of fossil fuels and minerals.

This has made possible an industrial process of production based on a level of energy-matter conversion which is highly entropic (36). The environment must provide both inputs (raw materials, land, energy) and a "sink" for outputs (waste products of extraction, production, distribution and consumption).

The dual problems of depletion and pollution have occurred as the level of human demand or pressure has grown beyond the rate at which resources are supplied and the rate at which wastes are assimilated by the environment. Furthermore, the high level of throughput in the human system is only possible by diverting energy-matter from other subsystems of the biosphere and has resulted in widespread disruption of the complex pattern of energy-matter distribution which forms the ecosystems of the planet.

Global disorder has occurred as more and more resources have been removed from a situation where they were available to other subsystems and converted into materials and waste

forms which are not, thereby disrupting the natural cyclic flows of matter within the biosphere (37).

The entropy crisis is a warning that the high rate of energy use within industrial society is approaching the limits of the planet. Knelman (1978) believes that the expansion of industrial society is approaching a level of energy-matter conversion representing a significant fraction of total solar radiation. He predicts that limits in the form of thermal pollution and unacceptable climatic change could be experienced within the next 50 years.

5) A CRISIS OF HUMAN VALUES

Miller (1975) writes that from a physical standpoint, the environmental crisis is an entropy or disorder crisis but he considers this has come about from a human attitude which seeks to control nature; "... thus, paradoxically, the more we attempt to order or 'control' the earth the greater the stress we inevitably put on the environment".

Miller concludes that the environmental crisis is

(1) a crisis in human values - our attempts to order nature, and

(2) an entropy crisis - our attempts to ignore the second law of thermodynamics.

Similarly, Commoner (1971) believes that we are in an environmental crisis "because the means by which we use the ecosphere to produce wealth are destructive of the ecosphere itself"(38).He traces the environmental crisis from its overt

manifestations in the ecosphere to the ecological stresses which they reflect, to the faults in productive technology - and in its scientific background - that generate these stresses, and finally to the social, economic and political forces which have driven us down this self-destructive course:

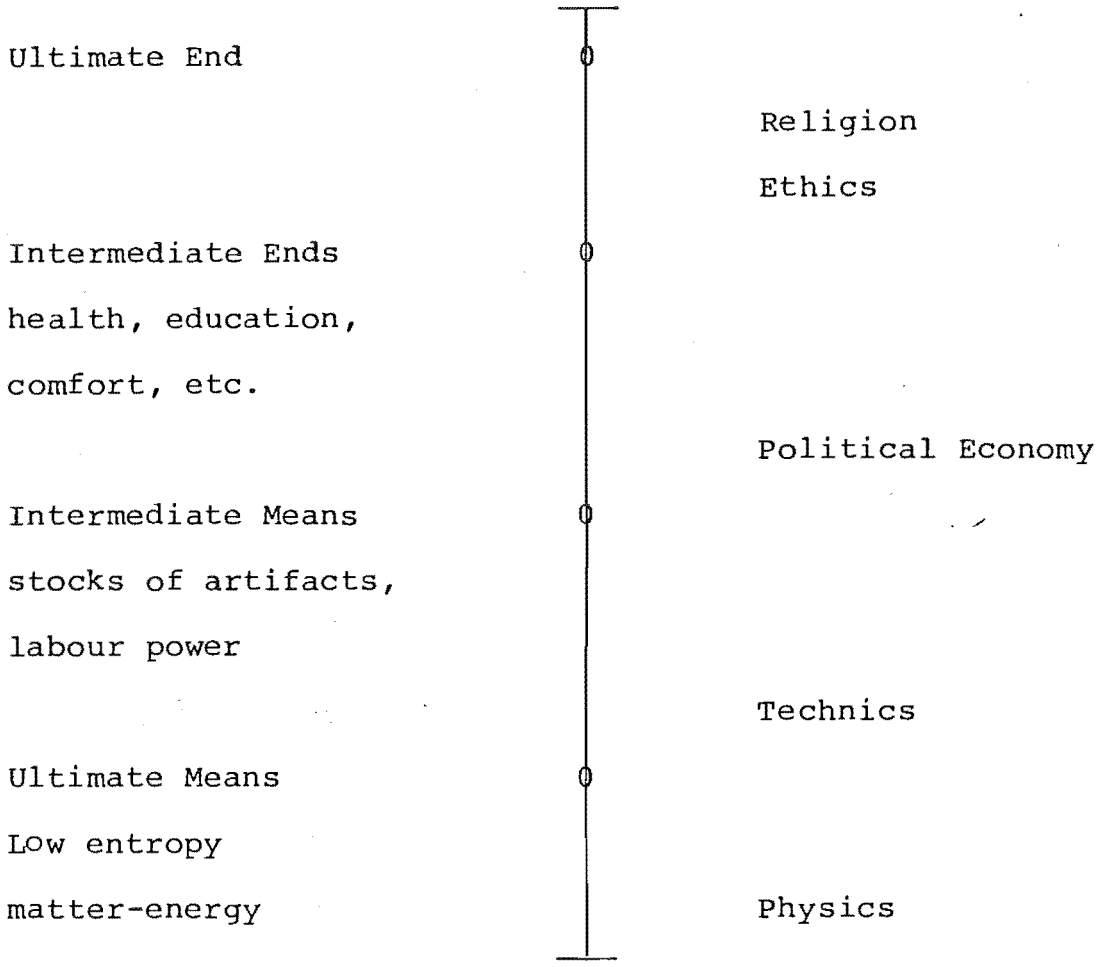
> "... the world is being carried to the brink of ecological disaster not by a singular fault, which some clever scheme can correct but by the phalanx of economic, political and social forces that constitute the march of history" (39).

Along with Miller, Commoner concludes that "human beings have broken out of the circle of life, driven not by biological need, but by the social organization which they have devised to 'conquer nature'..." (40).

The environmental crisis, therefore, is a crisis at two levels: a physical problem related to the excessive use of energy by an expanding human population, and an ethical problem related to the attitude of industrial society toward the natural world.

Daly (1980) believes that industrial society has persisted with environmentally damaging behaviour due to an ignorance of the biophysical means that support the economy and an avoidance of the ethical values or 'ends' which question the unlimited consumption of material goods.

In his book *Economics, Ecology, Ethics,* Daly produces the following "Means-Ends Spectrum":



According to Daly, modern society's excessive devotion to economic growth stems from an incomplete view of the "means-ends spectrum" (41): it has falsely assumed that the middle range represents the whole spectrum. The vision is one of "continuous growth in intermediate means (unconstrained by any scarcity of Ultimate Means) in order to satisfy ever more intermediate ends (unconstrained by any imposition from an Ultimate End). Infinite means plus infinite ends means infinite growth forever" (42). Along with several other economists (notably Schumacher, Georgescu-Roegen, Boulding and Mishan), Daly believes that the environmental crisis stems

primarily from an inappropriate industrial world view which must be replaced by one more in harmony with ecological reality. This involves a reconciliation of the means of human survival with its ultimate biophysical limits and its spiritual ends.

6) CONCLUSION

In this chapter I have argued that the environmental crisis is merely the symptom of a global entropy crisis which has occurred as industrial society expanded its energy use beyond the limits of the ecosystems on which it is dependent. This expansion has been associated with a world view which seeks to conquer nature but which is now increasingly regarded as inappropriate in a world of finite limits.

The conceptual response to the environmental crisis has produced a new level of awareness which seeks to reconcile the ultimate biophysical means of human survival with its spiritual ends.

It is interesting to note that the word 'crisis' comes originally from the Greek 'Krisis' which means a decision. The environmental crisis is a sign that humanity faces a major turning point in its development and that the age of industrialism may be drawing to a close.

Garret Hardin has written that during the 1960s civilization passed over a threshold, into the "Age of Ecology":

> "We had entered the Space Age ... but only in an ironic sense. By the end of the decade it was obvious that the only space that really mattered was not the space out there ... on a useless moon. The space that really matters most to us now is inner space, the space inside our heads ... in which we build our conceptions of the external world and of how humanity fits into it" (43).

Caldwell (1972) concludes that the environmental crisis is an outward manifestation of a crisis of mind and spirit:

> "There could be no greater misconception of its meaning than to believe it to be concerned only with endangered wildlife, man-made ugliness and pollution. These are part of it, but more importantly, the crisis is concerned with the kind of creature man is and what he must become in order to survive."

GROWTH IN A FINITE WORLD

1) INTRODUCTION

2) THE WORLD SYSTEM

2.1 Exponential Growth

2.2 Finite Limits

- Population Growth Forms
- Growth of the Human System
- The Transition to a Steady State
- Options for Industrial Society

2.3 Processes Controlling Growth

- The Image of Growth
- Positive and Negative Feedback Controls
- Delay in Negative Feedback Control

3) CONCLUSION

GROWTH IN A FINITE WORLD

1) INTRODUCTION

In 1972, the Club of Rome published *The Limits to Growth* as part of its project on the Predicament of Mankind. Its conclusions provoked a storm of controversy (1), but despite the criticism of its methods, the fundamental message remains unchallenged: infinite growth in a finite world is not possible.

Using computer models, the authors found that if the present growth trends in world population, industrialization, food production, pollution and resource depletion continue unchanged, the limits to growth on this planet would be reached some time within the next one hundred years. This would cause a sudden and uncontrollable decline in population and industrial capacity.

However, they believed it was possible to alter these growth trends and establish a condition of ecological and economic stability that could be sustained far into the future. If industrial society could accept a self-imposed limitation on growth, the transition to a steady state could be made in a conscious and orderly fashion rather than imposed through catastrophic overshoot and collapse.

According to the Club of Rome, the transition to a steady state would be achieved through a change in values and social institutions. It would mean abandoning

assumptions about growth and progress which had been followed consistently and successfully by human society for nearly four hundred years.

2) THE WORLD SYSTEM

Meadows *et al.* identify three fundamental properties of the world system: exponential growth, finite limits and a delay in the feedback processes which control growth.

2.1) Exponential Growth

Exponential growth involves a doubling of a system variable over a fixed time interval. The increase in doubling is approximately equal to the sum of all preceding growth (2).

The growth in world population and industrial capacity is inherently exponential (3). This creates an exponential demand for both non-renewable resources, such as minerals, and renewable resources, such as flowing water. In a world of finite limits, there is consequently an exponential growth in problems of pollution and over-population[1].

Forrester (1971) warns that exponential growth can be "treacherous and misleading" because a system variable can continue through many doubling intervals without seeming to

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1. In 1975 the world had a population of 4 billion and a 1.9% annual growth rate. This means a doubling interval of 36 years (4).

reach any significant size. However, suddenly in one or two more doublings, it becomes overwhelming (5). Bartlett (1978) emphasises this fundamental property of exponential growth with an illustration of the growth of a bacteria population within the finite boundaries of a bottle.

Given a doubling period of one minute in the hour before 12 noon, the bottle remains half empty up until 11.59 a.m. It is only in the final minute that it is completely filled. This explains why problems of pollution and resource depletion have reached crisis proportions so suddenly in recent history.

Goldsmith *et al.* (1972) state that indefinite growth of *any kind* cannot be sustained by a finite resource base:

> "This is the nub of the environmental predicament. It is still less possible to maintain indefinite exponential growth." (6)

2.2) Finite Limits

There are finite physical limits on the earth to the growth of human population and industrial capacity. Meadows (1973) defines these in terms of

(i) a finite stock of exploitable resources,

(ii) a finite capacity for the environment to absorb pollutants,

(iii) a finite amount of arable land,

(iv) a finite yield of food which can be obtained from each hectare of arable land, and

(v) a finite rate of use of renewable resources.

These limits cannot be precisely located in time or space. Rather, they are a qualitative representation of the dynamic inter-relation of the diverse components of the ecosystem. Thus the boundaries of a sub-system are determined by the pattern of its interaction with its environment (other sub-systems) and will fluctuate within a range of stability (7).

The interaction of the human population with its environment is determined by the level of its ecological demand in relation to the carrying capacity of the biosphere.

Ecological demand is a function of the rate of resource extraction and the return of wastes to the environment (8). It can be measured in terms of Gross Domestic Product (G.D.P.) or population multiplied by the material standard of living (9).

Carrying capacity is a measure of the maximum permanently supportable load or the number of a population living in a given manner which a given environment can support indefinitely (10). When the load is somewhere below carrying capacity, there is room for the expansion of numbers or of resource consumption per head of population. Liebig's 'law of the minimum' explains that whatever necessity is least abundantly available, (relative to the per capita requirements of the population) sets the environment's carrying capacity. Thus carrying capacity is limited "not just by food supply, but

potentially by any substance or circumstance that is indispensable but inadequate" (11).

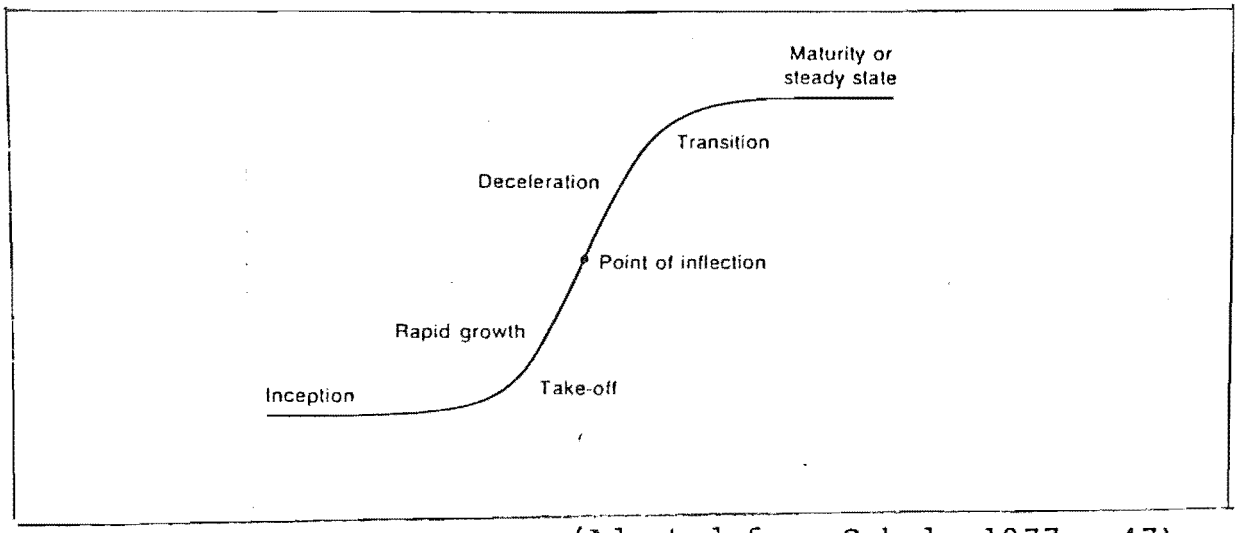
Growth beyond carrying capacity leads to *ecological scarcity*. According to Ophuls (1977) this includes biospheric constraints such as Malthusian scarcity and a shortage of non-renewable resources, limits to the human capacity to raise carrying capacity with new technology, and the social and economic costs associated with unrestrained growth. Social and psychological limits to growth are also recognised by Mishan (1973), Hirsch (1976), Leiss (1978) and Daly (1973) and may appear in advance of physical limits (12).

"Population Growth Forms"

Odum (1971) identifies two basic patterns of population growth forms.

The first is a J-shaped curve in which population density increases exponentially and then stops abruptly as environmental resistance becomes effective. The S or sigmoid curve shows a slow initial growth rate (positive acceleration phase) followed by rapid growth (logarithmic phase) which is gradually slowed as environmental resistance increases (negative acceleration phase) and an equilibrium level is reached (13).

Ophuls (1977) identifies the following features of the sigmoid curve:



(Adapted from Ophuls 1977 p.47)

During ecological succession, the growth or pioneer phase of the population displays markedly different characteristics from the mature or climax phase. Ophuls summarizes these as follows:

Pioneer Phase	Climax Phase
Few species	Many species
One or few species dominate	Relative equality of species
Quantity growth	Quality growth
Few Symbioses	Many symbioses, mostly cooperative
Short, simple life cycles	Long, complex life cycles
Mineral cycles relatively open and linear	Mineral cycles circular and closed
Rapid growth	Feedback control (homeostasis)
Relatively inefficient use of energy	Efficient use of energy
Low degree of order (high entropy).	High degree of structured, complex order (low entropy).

(Source: Ophuls 1977 p. 36 Table 4)

McHarg (1969) characterizes the growth phase as one of immaturity, simplicity, uniformity, fragility, poverty,

quantity and high entropy. The climax phase is one of maturity, complexity, diversity, stability, organization, richness, quality and low entropy. He argues that a transition from the pioneer to the climax phase is an evolutionary change and that movement in the opposite direction is retrogressive. Furthermore, he states that the characteristics of the climax phase are a sign of ecosystem health whereas the high growth, high entropy phase is a sign of ill-health[1].

"Growth of the Human System"

Instead of progressing towards the mature phase of ecological succession the human species has persisted with adolescent growth. Industrial society continues to exhibit many characteristics of the pioneer phase of development: domination of the environment by one species, high levels of growth (based on the assumption of a limitless frontier of resource opportunities), and aggressive competition between individuals.

The modern 'cowboy economy' (14) is based on maximizing production flow rather than maintaining the quality of a constant stock (15); the high rate of linear throughput of energy and matter is increasingly entropic.

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1. I would argue that both phases are healthy and integral to ecosystem evolution. Moreover, the climax or steady-state is not a terminal state, i.e. equilibrium is not static but will fluctuate and may even be lost altogether and re-established at a different level.

However, industrial society has reached the point where abundant growth is now increasingly constrained by ecological scarcity, in the form of global pollution, ecosystem disruption, famine, the 'Energy Crisis' and 'stag-flation' (16). On this basis, Ophuls believes that industrial civilization has passed the point of inflection and has begun the transition to a steady state.

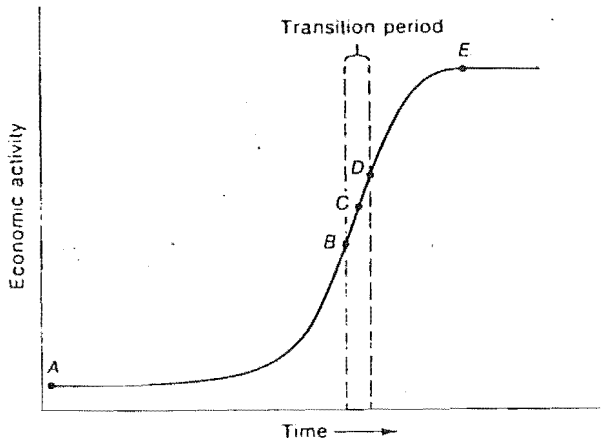


FIGURE 3-1
Growth curve of industrial civilization: *A*, steady state (beginning of accelerating growth); *B*, end of unrestrained growth (beginning of transition period); *C*, point of inflection (beginning of deceleration); *D*, end of transition period; *E*, terminal steady state.

Source: Ophuls 1977 p.130

The human system has entered the zone of transition: the the era of unrestrained growth may soon be passed (17).

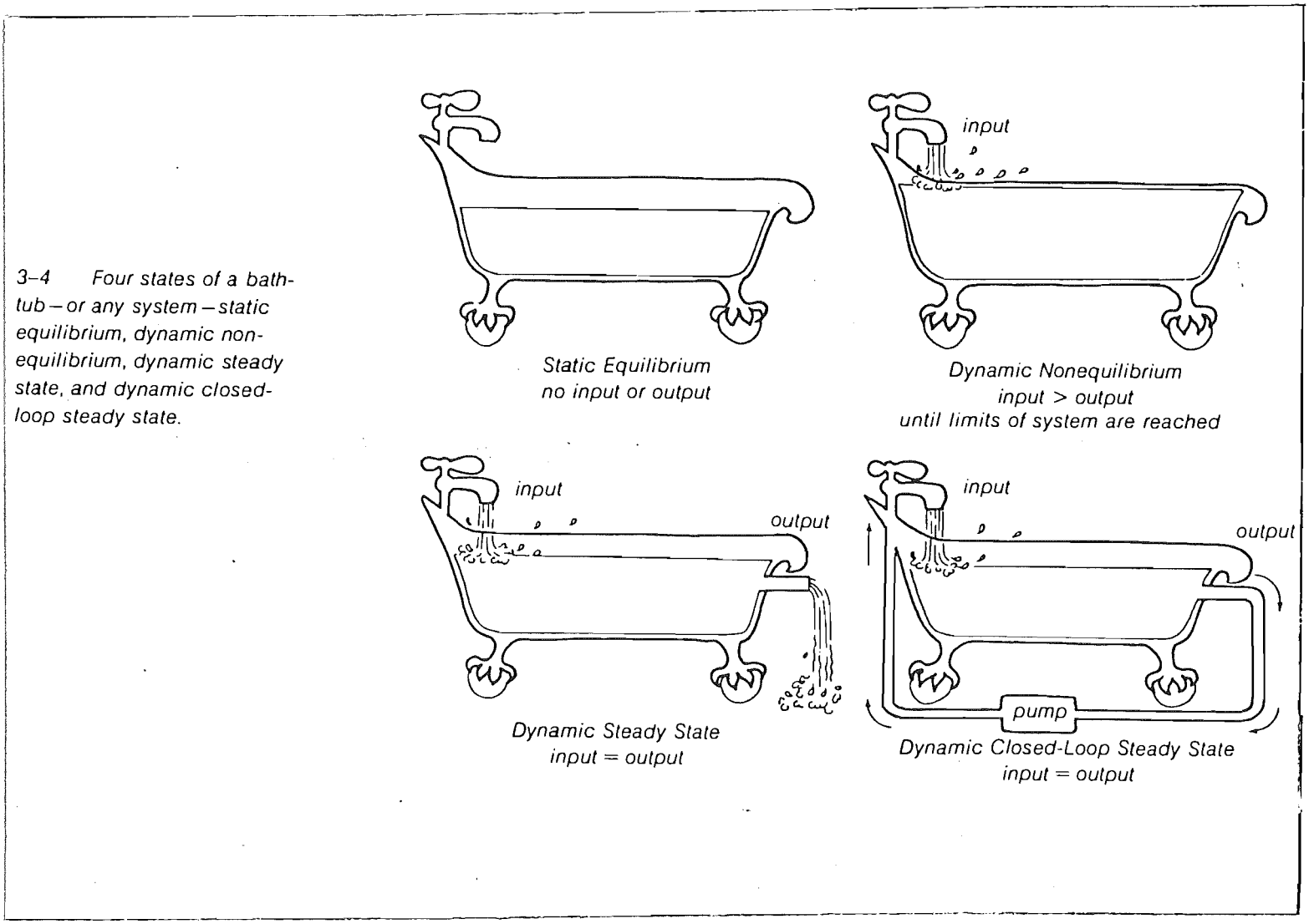
"The Transition to a Steady State"

What does the transition to a steady state mean for industrial society?

Daly (1980) writes that it would involve an immediate halt to population and economic growth and the establishment of a system with a constant stock of physical wealth and numbers and a low rate of throughput. This would mean a

longer life span for both goods and people.

Miller (1975) uses the following graphics to illustrate the dynamics of systems:



3–4 Four states of a bathtub—or any system—static equilibrium, dynamic nonequilibrium, dynamic steady state, and dynamic closed-loop steady state.

(Source: Miller (1975) p.38 Fig. 3-4).

A steady-state is a dynamic rather than a static state, in which input and output are balanced. There is a continuous throughput within the limits of the system.

A whole series of different steady states (different possible water levels) is possible so long as "we don't exceed the limits of the tub" (18). However, this still represents a linear system because "water is flowing through

the system and presumably being wasted. If water is scarce we can close the loop and recycle it ...". Once the system becomes cyclic, demand for the resource is reduced. In this model, the rate of throughput will depend on the size of the water pipes, the rate of water supply, the capacity of the pump and rate of energy supply to run it. The steady state is a dynamic balance of these variables (19).

As Chapter 1 explained, the biosphere operates as a closed system in which energy but not matter is exchanged between the system and its surroundings. Life is only possible with an outside energy input (the sun) and an internal system for recycling materials.

Within the biosphere, the global energy flow is used by living and non-living subsystems, which maintain a balanced exchange of energy and matter with their environments.

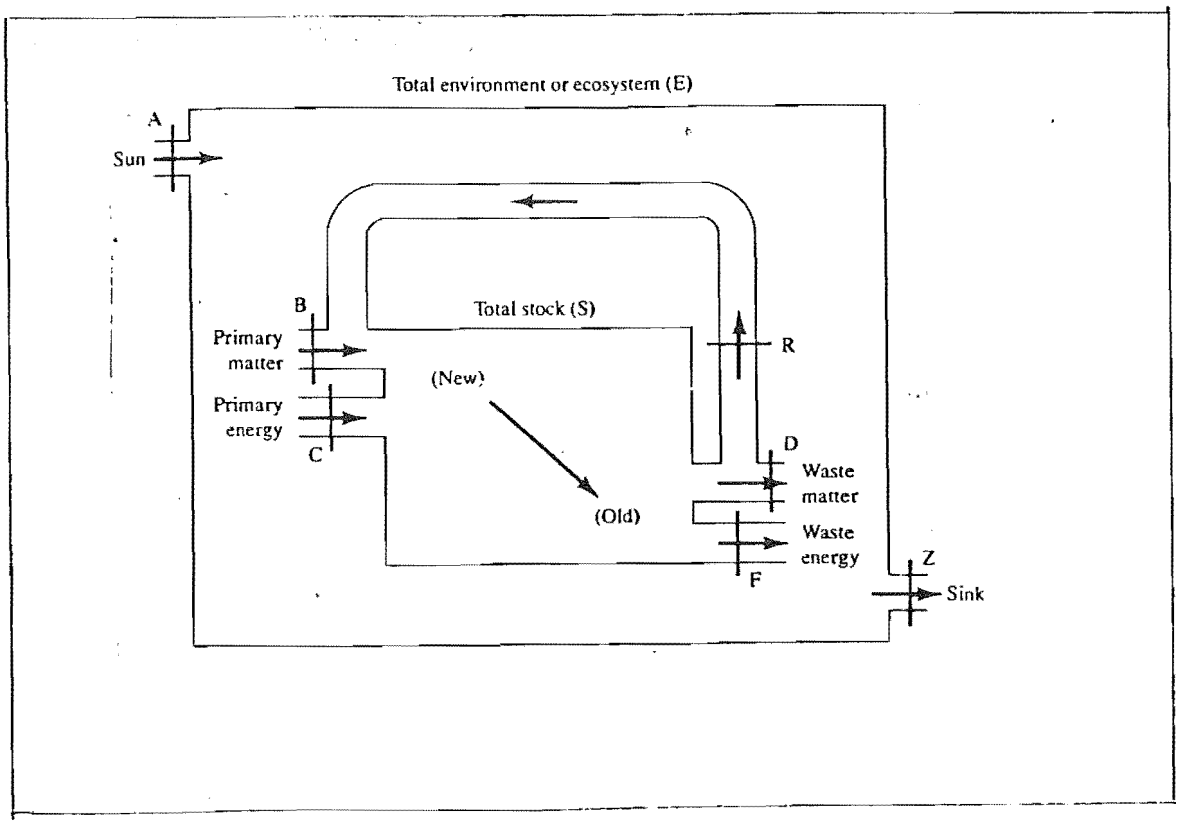
Given the finite rate of energy flow entering the biosphere, the rate of energy use in one subsystem will determine the energy use of others. The biosphere is structured into ecosystems by the dynamic energy balance (interdependence) between subsystems.

The human system, by expanding its ecological demand has exceeded the rates of energy flow (resource supply) of its habitat. Commoner (1971) writes that "we have broken out of the circle of life, converting its endless cycles into man-made linear events".

Industrial society has developed by invading the earth's 'biological capital' (energy-matter stocks) instead of living on 'income' (energy-matter flows) (20). Daly (1980) writes:

> "Since matter and energy cannot be created, production inputs must be taken from the environment which leads to depletion. Since matter and energy cannot be destroyed, an equal amount of matter and energy must be returned to the environment, leading to pollution. Hence lower rates of throughput lead to less depletion and pollution, higher rates to more." (21)

He produces the following model of the ecosystem:



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Rectangle (E) is the total ecosystem, which contains the total stock (S) of wealth and people as one of its mutually dependent components. The ecosystem imports energy from outer space (sun, A) and exports waste heat to outer space (sink, Z). The stock contains matter in which a considerable amount of available energy is stored (mined coal, oil in oil tanks, water on high ground, living things, wood products, and the like), as well as matter in which virtually no available energy is stored. Matter and energy in the stock must be separately maintained. The stock is maintained in a steady state when B is equal to D and C is equal to F. In the steady state throughput equals either input (B plus C) or output (D plus F), since input and output are equal to each other. When input and output are not equal, then the throughput is measured by the smaller of the two.

From the second law of thermodynamics, we know that energy cannot be recycled. Matter may be recycled (R), but only by using more energy (and matter) to do it. In the diagram, energy moves only from left to right, whereas matter moves in both directions.

For a constant S, the lower the rate of throughput the more durable or longer-lived is the total stock. For a given throughput, the lower the rate of recycling (R), the more durable are the individual commodities. The optimum durability of an individual commodity is attained when the marginal production cost of increased durability equals the marginal recycling cost of not having increased durability further. *Cost* is total ecological cost and is extremely difficult to measure.

Both the size of the stock and the rate of throughput must not be so large relative to the total environment that they obstruct the natural ecological processes which form the biophysical foundations of wealth. Otherwise, the total stock and its associated throughput become a cancer which kills the total organism.

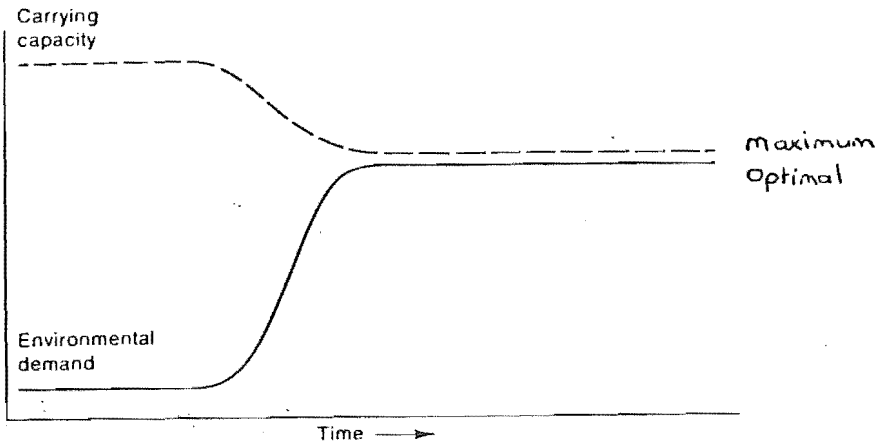
Source: Daly, 1980
p.20

Daly concludes that "the best use of resources would imitate the model that nature has furnished: a closed-gap system of material cycles powered by the sun"(22). A steady state society would reduce and stabilize the rate of energy-matter conversion or throughput in its economy and would rely primarily on renewable resources.

Ophuls identifies three possible transition scenarios for the human population.

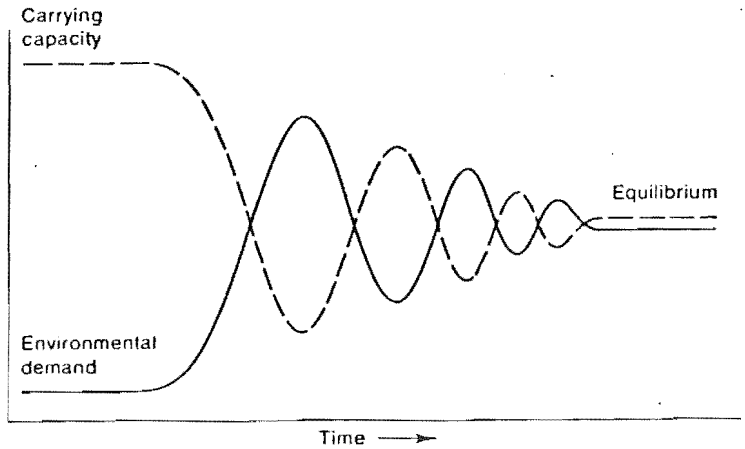
The first involves a smooth transition to equilibrium. Environmental degradation slows population growth and lowers carrying capacity and equilibrium is established at an optimal level, somewhere beneath maximum carrying capacity.

This 'ecological safety margin' allows for a trade-off between the components of environmental demand: a lower population with a high level of resource use as opposed to a large population surviving at subsistence level (23):

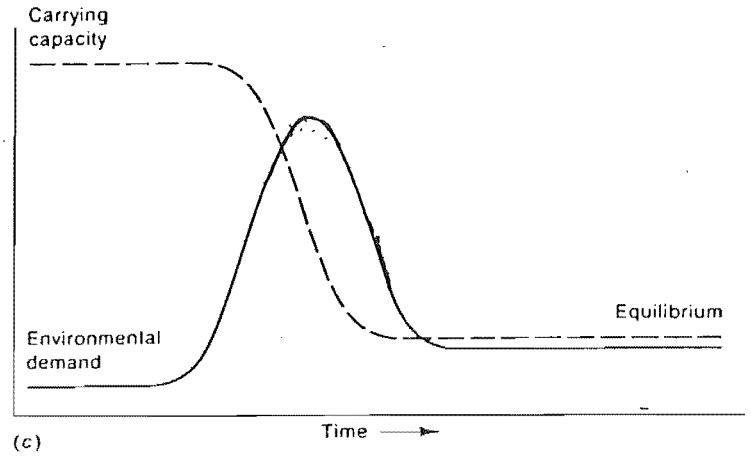


Source: Ophuls, 1977. P.135

The second scenario points to a reduction in carrying capacity, caused by environmental degradation, leading to an overshoot followed by a series of oscillations and a much lower level of equilibrium:



Thirdly, a drastic overshoot of carrying capacity would lead to a major population crash and a significantly lower level of equilibrium:

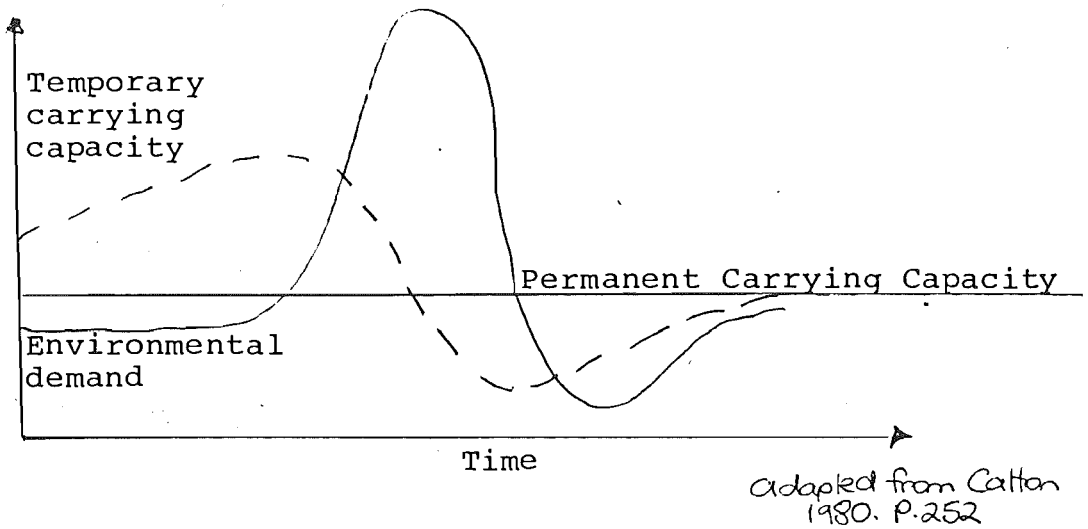


Which is the most likely scenario for industrial society? In many places, "whenever one can observe dangerous levels of pollution, serious ecological degradation or widespread disturbance of natural balances", carrying capacity had already been exceeded (24). Ophuls believes that industrial civilization "will be obliged to make an abrupt transition from full-speed-ahead growth to some kind of equilibrium or steady state in little more than one generation".(25)

However, Catton (1980) insists that regardless of local incidents of overshoot, the growth of industrial society has *already* exceeded the permanent carrying capacity of the planet.

The development of industrial society has only been possible by increasing the level of resource consumption or rate of energy use in the human system. More importantly, its development has depended upon consuming the Earth's

limited stocks of stored solar energy (fossil fuels) (see Chapter 1). Now that this source is virtually exhausted it can be seen that industrial man has been living at an artificially high and strictly temporary level of carrying capacity:



Adapted from Catton 1980. P.252

Boughey (1975) explains that the carrying capacity for human populations has been forced upward in a progressive series of steps:

> "Each step represented some cultural advance, like elimination of some competitor or over exploitation of some resource with a consequent over-riding of the various regulatory mechanisms restricting the population growth .... As the ecosystems ... could not receive any greater increase of energy, this increased ... population could only be achieved in one of two ways. It could be effected if there were a corresponding reduction in the biomass of competing species populations ... or it could be achieved by 'mining' accumulated resources of the ecosystem ...". (26)

Catton maintains that with the end of fossil fuel resources, the 'age of exuberance' is over. The present 'colossal' society could only continue to exist by taking over even more of the earth's life support systems at the expense of other species. Further resource consumption

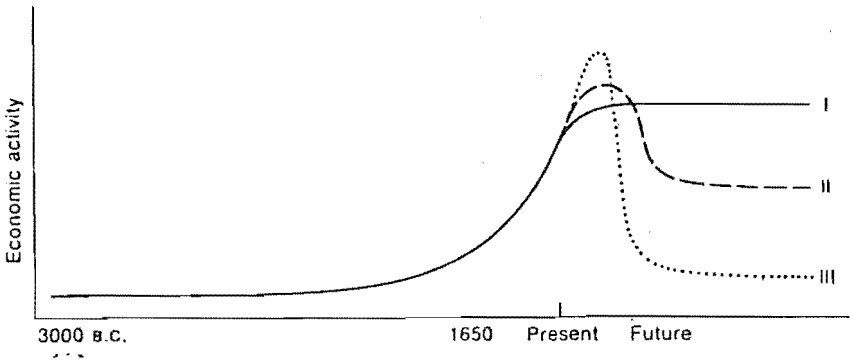
could only worsen the environmental crisis by increasing the total entropy of the planet. It is possible that an accelerating state of global disorder would undermine the stability of the entire biosphere (27).

"Options for Industrial Society"

On this basis it would seem that contrary to the suggestion of the Club of Rome, there is no choice available to humanity to make a simple transition within limits and avoid the impending collapse. As Catton remarks, there is no magic recipe for avoiding crash when overshoot has already happened.

The only choice that remains is either to control the growth of human numbers and resource consumption *now* and 'die-back' to a moderate level of equilibrium, or to continue to grow and be assured of a completely disastrous collapse of the human system,which would leave a piteously low population at a vastly simplified level of existence.

Ophuls (1977) provides the following overview:



"The Ecological History of the World"

(Adapted from Ophuls (1977) p.136)

He believes that humanity stands at "a genuine civilizational crossroads" (28). Overshoot would mean a significantly lower steady-state level (II) than could have been achieved by carefully planned and timely action (I), or a level tantamount to a reversion to a pre-modern, agrarian way of life (III). The entire Industrial Revolution would appear as "a brief and anomalous spike in humanity's otherwise flat ecological trace, a transitory epoch of a few centuries duration in which it seemed momentarily possible to abolish scarcity" (29).

Catton concludes:

> "the paramount need of post-exuberant humanity is to remain human in the face of dehumanizing pressures. To do this we must learn somehow to base exuberance of spirit upon something more lasting than the expansive living that sustained it in the recent past." (30)

Or, as Daly would have it, the steady state must be a society of biophysical equilibrium and moral growth.

2.3) Processes Controlling Growth

"The Image of Growth"

Meadows *et al.* (1972) found that "the basic behaviour mode of the world system is exponential growth of population and capital followed by collapse" (31). The standard run of the world model developed at M.I.T. showed that an extrapolation of current growth trends to the year 2100 resulted in a diminished resource base followed by a reversal of food production and industrial output, a rise in pollution and an eventual overshoot and collapse of

population. Even with the simultaneous incorporation of four technological policies (increased resources from new technology and recycling, pollution controls, increased agricultural production and 'perfect' birth controls), the model indicated that industrial growth would still be halted before 2100. Collapse occurs with a rise in the death rate as resources are depleted, pollution accumulates and food production declines.

Meadows *et al.* concluded:

> "the unspoken assumption behind all of the model runs ... is that population and capital growth should be allowed to continue until they reached some 'natural limit'. This assumption also appears to be a basic part of the human value system currently operational in the real world. Whenever we incorporate this value into the model, the result is that the growing system rises above its ultimate limit and then collapses" (32).

It is at this point that the authors of *The Limits to Growth* make a fundamental connection between the behaviour of the human system and the world view or "image" (33) it holds of its environment.

Exponential growth in industrial society has occurred under a world view which considers that resources are infinitely abundant and that the continued expansion of production and population (consumers) was both necessary and desirable.

In the process of ecological succession, the growth of a population will inevitably cause changes in its environment.

Subsequently, the image guiding its behaviour will also change once new conditions are experienced with the

establishment of a steady-state or climax community (34). The human population has not only filled its own ecological habitat but has continued to grow, exceeding the carrying capacity of its environment and taking over the habitats of other species until it dominates the entire biosphere (35).

Now that the limits of its environment have been exceeded the world view which promotes growth is no longer appropriate. Contrary to the earlier stages of human succession, further population growth (in the neo-Malthusian sense) is now a threat to the survival of the species.

"Positive and Negative Feedback Controls"

Exponential growth in a finite system is produced by *positive feedback loops,* in which a chain of cause and effect relationships closes on itself so that increasing any one element will produce a series of changes that will eventually increase it even more.

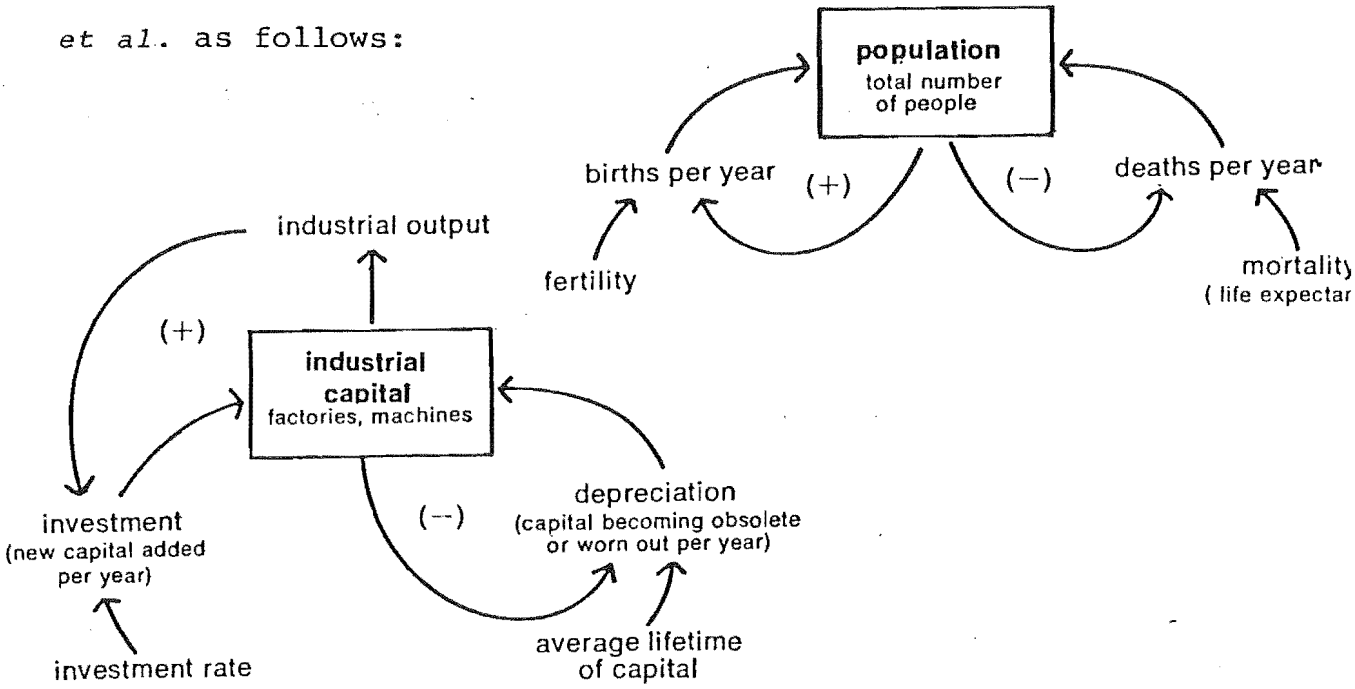
Conversely, *negative feedback loops* act to regulate growth and hold a system in a steady-state. A change in one element will eventually lead to a change in that element in a direction opposite to the initial change (36). A steady-state therefore, is a system held in balance by positive and negative controls.

Positive and negative feedback loops maintain a cybernetic relationship between a system and its surroundings, i.e. the behaviour of the system is determined by information fed back into it from its environment. The set of information

held by a system represents the image which guides its development.

In a finite system, population growth is rewarded by positive feedback loops and will continue until negative feedback comes into operation. Negative loops become stronger as growth approaches the limits of the environment and will finally overcome the growth rewarding mechanisms and equilibrium will be reached (37).

The central feedback loops associated with human population and capital growth are described by Meadows *et al.* as follows:



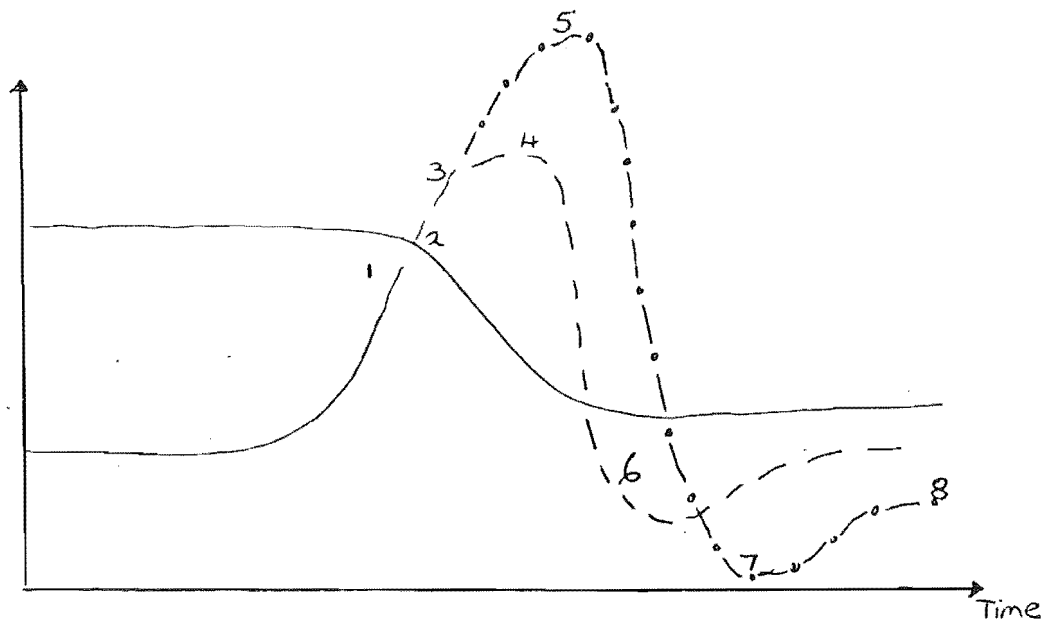
Source: Meadows *et al.* (1972) p.95.

Negative feedback controls include such processes as pollution of the environment, depletion of resources and famine and social constraints on growth such as over-crowding and economic stagnation.

"Delay in Negative Feedback Control"

Because of the delays inherent in the action of negative feedback loops, growth in the ecological demand of the human system has gone beyond the carrying capacity of its environment.

In the following diagram, carrying capacity is lowered by accelerating growth (1) and overshoot occurs (2), evidenced by widespread environmental degradation. Even if negative feedback controls are activated before overshoot, the time lag in the system means that growth will continue (3) until the controls take effect (4) and the population collapses (6).

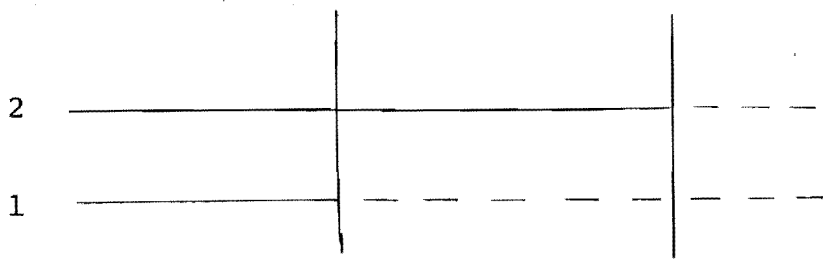


A serious overshoot (5) may cause the population to 'die-back' (7) to a new equilibrium considerably lower than the original level (8). Therefore the point at which negative feedback controls come into effect will determine the size of the population to be sustained in the new steady state.

Time lags in the world system are the result of both natural and cultural delays. Together these factors work to prolong the time between the development of a problem (dysfunction) in the environment, recognition of the event, the implementation of corrective action and the effect of that action.

Ogburn (1923) makes a distinction between the material and the adaptive aspects of human culture:

> "When the material conditions change, changes are occasioned in the adaptive culture. But these changes ... do not synchronize exactly .... There is a lag which may last for varying degrees of time." (39).



1) Material conditions 2) Adaptive culture

Adapted from Ogburn 1923 p.206

The old adaptive culture may 'hang over' longer than it should; the space between a) and b) represents a period of maladjustment which is less harmonious than the period which precedes or follows. Ogburn observes that the growth of material culture and the changes it is producing is going increasingly faster and "since there are many rapid changes in material culture, it follows that there will be an accumulation of ... lags and maladjustments" (40).

Cultural delays are compounded by natural delays. For example, if birth control policies were implemented and the world population reached a replacement family size by the year 2000, at which time the population would be 5.8 billion, the delays caused by the age structure would result in an eventual population of 8.2 billion (41).

Secondly, pollutants may be relatively harmless until an ecosystem threshold is exceeded or until they accumulate at the end of a food chain. Synergetic effects may also appear only after a temporal or spatial lag.

However, the dysfunctional effects of depositing excess waste into an ecosystem may not be recognised until the symptoms of the problem become visible to society. As Chapter 1 suggests, there may be a further delay if pollutants are ignored until they seriously threaten human welfare.

Frequently, the visible or noxious symptoms are treated with band aid remedies (such as chimney filters or expensive chemical agents) and the underlying cause is misunderstood or disregarded. Miller (1975) comments that a solution may be environmentally, technologically and economically feasible but it will not be implemented if it fails the test of political feasibility (42). Any proposal which challenges the underlying reason for environmental degradation (excessive conversion of energy and materials) is likely to be vigorously opposed by adherents to growth. As a result, 'solutions' aimed at symptoms merely exacerbate the problem by allowing it to continue.

Delays in dynamic systems have serious consequences only if the system is undergoing rapid changes (43). If human pressure on global ecosystems was growing only slowly, the effects of policies could be evaluated before new policies were instituted. "Under conditions of rapid growth, however, the system is forced into new policies .... The situation is even worse when the growth is exponential" (44). Thus overshoot has occurred before the system has been able to react to stop growth.

The danger for the human population lies in the global consequences of overshoot, following delays in negative feedback. For example, significant quantities of long-lived radioactive waste have already been dumped in the oceans and will remain a threat to marine life (and potentially to human health) regardless of whether political pressure forces a halt to dumping in the future. The rate of energy use in industrial society has caused irreversible changes in the biosphere, shutting off opportunities for environmental recovery (and human sustainability) in the future.

The only possibility for preventing further mistakes depends on a fundamental change in political values, in effect a *reduction* in the positive feedback loops which promote growth. Thus, instead of waiting until negative feedback controls came into effect, the human system could deliberately alter its behaviour mode.

Forrester (1973) writes:

> "It is certain that resource shortage, pollution, crowding, food failure or some other equally

> powerful force will limit population and industrialization if persuasion and psychological factors do not....[But] the natural mechanisms for terminating exponential growth appear to be the least desirable." (45)

If industrial society could consciously choose to alter its value system it could work toward the early establishment of a steady state and avoid a disastrous overshoot and collapse.

3) CONCLUSION

Exponential growth in the ecological demand of the human system has taken it beyond the limits of its environment.

Growth in industrial society is now increasingly constrained by ecological scarcity. Having overshot carrying capacity, the human system has begun the transition to a steady state.

The level of carrying capacity to be enjoyed by the steady state population will be determined by the extent to which exponential growth in the industrial world is allowed to continue. Further growth will bring severe natural constraints into effect and the human population may 'die back' to a vastly simplified existence.

A change in the human value system would weaken the positive feedback forces promoting growth and make possible a deliberate transition to a steady state society.

Meadows (1973) concludes:

> "Physical growth of population and capital will stop on this finite planet. The only uncertainties

lie in when it will stop and how - by deliberate social choice and careful human management or by the harsh backlash of a disturbed and depleted natural environment." (46)

ADJUSTING TO LIMITS

1) INTRODUCTION

2) CYBERNETIC SYSTEMS

3) THE HUMAN SYSTEM

- Introduction
- Human Evolution
- 'Homo sapiens industrialis'

4) ADJUSTMENT OF THE HUMAN SYSTEM

5) CONCLUSION

ADJUSTING TO LIMITS

1) INTRODUCTION

In this chapter the environmental crisis is interpreted as a signal from the biosphere that Industrial Man has exceeded the limits of the ecosystems on which he is dependent. Commoner (1971) writes:

> "The environmental crisis is a sign that the finely sculptured fit between life and its surroundings has begun to corrode.... As the limits between one living thing and another and their surroundings begin to break down, the dynamic interactions that sustain the whole have begun to falter and in some places to stop."(1)

Environmental breakdown constitutes a message that the activities of the human species are increasingly dysfunctional and human behaviour must be re-adapted to the reality of biophysical limits. An alteration of the behaviour of the human system, in the light of information fed back to it from its environment, represents a *cybernetic adjustment*. During evolutionary history, such adjustments have enabled other species to adapt to changed conditions and survive.

2) CYBERNETIC SYSTEMS

The word cybernetic is derived from the Greek word for helmsman, and means to steer or to govern. The helmsman on a ship forms part of a system along with the rudder and the compass. If the ship veers off the chosen compass course, the change in the compass needle is observed and interpreted

by the helmsman who turns the rudder, guiding the ship back to its original course. If he moves the rudder too far in response this shows in the compass, which signals to the helmsman to correct his over-reaction by an opposite movement. The operation of this cycle stabilizes the course of the ship, i.e. the system is kept in a steady state (2).

Cybernetics describes the processes of coordination, relation, regulation, communication and control in any organized system (3). McNaughton and Coughenour (1981) state that cybernetic systems have three essential properties:

1) They are open to energy and often matter but closed to information and control,
2) Information consists of facts that take on meaning only in a certain context, thus
3) the basic building block of a cybernetic system is a feedback loop that regulates the transformation of matter or energy because the regulator has access to information concerning the state of the system.

Cybernetic systems are goal seeking or homeostatic. Stability is maintained by negative feedback loops such that "when the system is perturbed the goal directed feedback cycles act to reduce the effect of the perturbation" (4). Cybernetic systems involve a large number of elements with complex and intricate inter-relationships, connected together by an information network which guides the system. The action

of any one element ultimately influences all the other elements. This interaction generates continuous changes over time: the system is in an evolving dynamic state (5).

The biosphere and its sub-systems, can be viewed as a cybernetic system.

Miller (1975) explains that the natural tendency of any complex organism, group of organisms or ecosystem is to maintain a dynamic steady state, despite environmental stresses, changes and shocks. This allows the system to change so that it can maintain or alter necessary or desirable conditions. Thus the ecosystems which make up the biosphere "form a giant and elaborate set of cybernetic systems linked together by information feedback to preserve overall stability" (6).

Natural systems are designed by evolution to be self-maintaining and self-regulating. Through a homeostatic process, organisms and ecosystems make positive (change-amplifying) responses to stress or negative (change-eliminating) ones to achieve the goal of stability and survival (7).

Natural systems will respond to stress according to behaviour which has been successful in the past. Darwin called the process, by which useful variations are preserved, Natural Selection:

> "... any variation, however slight and from whatever cause proceeding, if it be in any degree profitable to an individual or any species in its infinitely complex relations to other organic beings and to external nature will tend to the preservation of

that individual and will generally be inherited by its offspring" (8).

In his book *The Survival of the Wisest*, the biologist Jonas Salk defines evolution as the process for extending the persistence of life on earth (9). Similarly, Slobodkin (1964) has described evolution as a game, in which the only pay-off is to stay in the game (10). Those organisms which are flexible enough to adjust to changes in their surroundings are more likely to be an evolutionary success and to survive.

Living things, however, do not merely adjust to their environment, they create it (11). By consuming resources (converting energy-matter) around it, an organism alters its environment and must, in turn, alter its behaviour. Thus there is a continual interplay between the behaviour or form of a system and the state of its surroundings.

A population will respond to any environmental change "by the initiation of a series of physiological, behavioural, ecological and genetic changes that restore its ability to respond to subsequent unpredictable environmental changes" (12). The structure of a natural system, therefore, is a reflection of the information it receives through interacting with its environment.

McNaughton and Coughenour (1981) explain that every manner of ecological interaction, such as competition, mutualism, parasitism and so on, involves information. "Ordered relationships such as these can only be maintained

through regulation and control, and control implies information" (13).

Ecosystems are permeated by information flows which are manifested in the flows of matter and energy and are responsible for maintaining or modifying system course (14). In this way, the structure of energy-matter in the biosphere can be understood as the arrangement of information, or as Salk (1973) would say, it is *in - formation.*

3) THE HUMAN SYSTEM

Introduction

Negative feedback controls work within a natural system to regulate its behaviour and, in a homeostatic process, keep it 'on course' toward the goal of stability and survival.

According to Ophuls (1977) if there is to be a system at all, there must be design limits:

> "No one part can be allowed to grow indefinitely displacing all others for this would destroy the system and consequently the part itself."(15)

When the limits of a system are exceeded, self-regulation mechanisms no longer work and the system is driven to runaway growth, in a "vicious circle of positive feedbacks", toward destruction. In the absence of negative feedback, growth becomes cancerous (16).

This pattern is now apparent in the human system: exponential growth has exceeded environmental limits due to a delay in negative feedback and a failure to reduce growth rewarding mechanisms. If the human population is to survive,

the image guiding its behaviour or form must be adjusted and reconciled with the information of the environmental crisis.

Human Evolution

Pirages (1978) notes that changes in human systems are generally governed by two types of evolutionary processes: biological and social. Biological evolution takes place within a pool of genetic information that is passed from one generation to the next through reproduction. Natural selection results from interactions between human genes and conditions in the physical and social environments. Those phenotypes which are in harmony with environmental conditions reproduce more successfully than those that are not (17).

A parallel evolutionary process takes place within human cultures. Information is stored in the cultural pattern, which includes the built environment, institutional structure and patterns of communication and is passed on from one generation to another (18).

Goldsmith (1978) considers that along with other natural systems, a society can be viewed as a cybernetic system. The persistence of the society depends upon a control mechanism which operates by detecting data essential to the maintenance of the system's stability, interpreting them in terms of the model the system has built up of its relationship with its environment and translating them into

action (19). This mechanism is a society's culture, which is composed of a specific world view or *Weltenschaunng* and the pattern of behaviour derived from it (20). Ogborn (1923) writes:

> "Social organization, customs and morals are the means of a collective way of doing things in large part to and with the natural environment."

Such methods of behaviour will change if the natural environment or the material culture changes (21).

Meadows (1973) states that the whole socio-economic system might be thought of as "a constant interplay of human desires and goals within physical and biological constraints" (22). From an energy perspective, Cottrell (1955) adds that energy is always a part of the process of choosing social values, which gives rise to social structure. When there is a change in the energy cost of achieving values there will also be a change in the normal order of choice. "Thus, the expectancies of repeated choice, which we call social structure, will undergo change" (23).

In summary, the extent to which the world view of the social system reflects a valid evaluation of its environment is related to the survival of the relevant civilization (24).

'Homosapiens Industrialis'

Turning now to the modern human system, Pirages (1977) makes a useful connection between the fossil fuel base and the institutions of industrial society:

> "For the past three hundred years, industrial societies have been experiencing a cornucopian revolution of plenty ... based on new technologies and ... the utilization of fossil fuels in doing

> work previously done by human beings and draft animals. ... [This] caused a "great transformation" in the norms, values, morals and growth expectations within newly industrializing societies. Pre-industrial societies, characterized by stability and resistance to change, were rapidly transformed into dynamic and rapidly growing industrial economies .... The increased abundance accompanying this trans-formation permitted many institutions which are now taken for granted to come into existence ...."(25)

The industrial revolution was financed by an abundant physical environment in which patterns of behaviour dependent on rapid growth were highly rewarded. However, as Dasmann (1976) explains, this society could only continue so long as energy supplies and raw materials were plentiful - "Now that they are no longer cheap or abundant, changes must be made." Ophuls (1977) writes that all our characteristic institutions - individualism, self-interest, laissez faire, wealth as a standard of worth - "were largely predicted on an abnormal historic era of virgin resources, unspoiled environments and rapid growth in applied knowledge that is now drawing to a close".(26)

Thus, the conventional attitudes of modern industrialism to the environment have been shaped by circumstances which are today largely irrelevant (27). Nearly four hundred years of industrial dominance of the biosphere has changed so much of the world that it resembles less and less that habitat to which homosapiens is genetically fitted (28).

But having radically altered its situation in relation to the environment, industrial society has not yet reinterpreted the ancient goals and values to fit the new

situation. This has caused what Goldsmith (1978) describes as "cognitive maladjustment": the model held by society does not adequately represent the new situation and has ceased to be adaptive (29). In typically graphic style, Goldsmith writes:

> "Industrial man in the world today is like a bull in a china shop, with the single difference that a bull with half the information about the properties of china as we have about those of ecosystems would probably try and adapt his behaviour to the environment rather than the reverse. By contrast homo sapiens industrialis is determined that the china shop should adapt to him and has therefore set himself the goal of reducing it to rubble in the shortest possible time" (30).

4) ADJUSTMENT OF THE HUMAN SYSTEM

Wagner (1978) writes that we are the only species out of balance with our environment:

> "The relationship of other species to their environment is dynamic, but in the long-run steady state. Obviously no species, ours included, can indefinitely postpone the ultimate crunch when our needs can no longer be provided by the earth's environment. The longer we postpone putting our house in order, the sooner and more devastating the final collapse."(31)

Falk (1972) warns that over evolutionary history, many animals have failed to overcome the adaptive crises that placed their species in jeopardy:

> "Most species of mammals did not survive longer than 500,000 years. Man has already been on earth for more than 1,000,000 years. Of the 500,000,000 forms of life that have existed on earth, 498,000,000 are extinct. Unless man can make some extraordinary changes in his patterns of social and political behaviour, he may well soon follow the dodo and the dinosaur down the path to extinction."

To survive, 'homo sapiens industrialis' must change his world view to match the realities of a changed environment. As a first step, writes Falk, we need to develop a clear awareness of the present situation not only with respect to its problems, as symptoms, but with regard to the underlying disorder, as cause[1].

As it was suggested in Chapter 1, the environmental crisis is largely the unintended results (32) of the exploitation of high levels of energy, based on a world view which is no longer appropriate. Only once the social origins of the environmental crisis are made clear can we take appropriate action (33). The authors of *The Limits to Growth* believe that the realization of the quantitative constraints of the physical environment and of the tragic consequences of overshoot are essential to the initiation of new forms of thinking that will lead to a fundamental revision of human behaviour. In their model of the world system, they found that if the social value system promoting material and population growth is replaced by one in favour of stability and against growth, overshoot no longer occurs and the system can be brought into a stable and equilibrium state.

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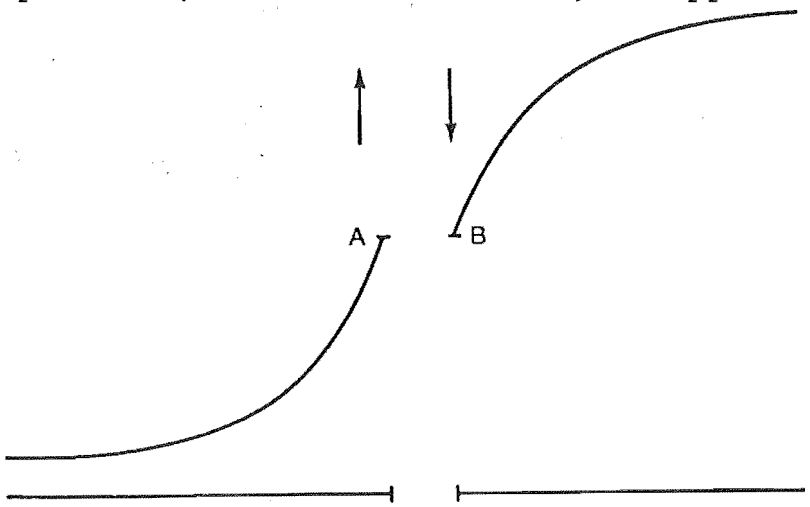
1. See Chapter 8 which takes up the theme of environing crises and the underlying crisis.

5) CONCLUSION

What becomes apparent from this discussion, is the underlying connections between the level of development of the human system, its energy base, social structure, and the information guiding its behaviour. The change in the energy base of industrial society is triggering new information and will lead to an entirely new social form.

Salk (1973) explains that at each point in the growth of a population, a different world view applies:



Source: Salk, 1973 p.23

Within the first part of the sigmoid curve, there is an emphasis on continued progress, growth and upwards expansion, whereas on the upper portion of the curve, modulation, control and establishing limits will apply. The break in direction at the point of inflection involves a switch from progressive acceleration to progressive deceleration. This is caused by a signalling operation: a change in direction in response to signals from the environment which will produce reactions appropriate to

survival (34). Along with a growing number of writers (see for example, Booker (1980), Pirages (1978), Pedler (1979) o: Stavrianos (1976)), Salk believes that industrial society has reached this point of inflection and is undergoing a profound change in cultural values. The attitudes of epoch A are being replaced in epoch B by entirely new concepts of the nature of human beings and their relation to the rest of the cosmos. This new cultural form, the post-industrial society, represents a reversal of A values and implies a fundamentally different future:

> "Man has reached a point, occurring in our time, when an epochal change is being experienced. This change is of such magnitude and significance that it may be judged to be of major importance in the course of human evolution. At this time, Man seems to be seeking tolerable levels quantitatively and is being called upon to develop qualitatively satisfying ways and means for living with himself and with others that fit what might be thought of as the scheme of nature. Man's choices will be "judged" by Nature, thus revealing the wisdom of his selections from among many alternatives" (35).

PART II PARADIGMS IN TRANSITION

INTRODUCTION

The global environmental crisis of pollution, depletion and overpopulation represents a growing challenge to the dominant world view of industrial society, which is grounded in a belief in technological and scientific progress associated with continuous economic growth. Goldsmith (1972) writes that environmental problems are "the warning signs of a profound incompatibility between deeply rooted beliefs in continuous growth and the dawning recognition of the earth as a spaceship, limited in its resources and vulnerable to mishandling".(1)

Knelman (1978) believes that this 'Growth-Progress' paradigm is coming to an end as its mythology succumbs to the reality of resource depletion. Images of a 'Technological Utopia' have been shattered by the harsh realities of energy shortages, inflation, food problems, urban decay, nuclear accidents and the population explosion (2). These crises have produced a growing sense of malfunction within industrial society, which is manifested by a number of deepening contradictions between the image it holds of its relationship to the environment and the information it is now exposed to. This contradiction is illustrated by Dasmann (1976) who writes:

> "All of the activities of the technocratic society are oriented toward the goal of 'progress' which is defined in terms of continuing economic growth. Yet the system is wasteful, destructive of the environment and unresponsive to human needs,

> except for those which can be satisfied with material goods. Furthermore, it is almost beyond human control." (3)

The depth of the crisis is also evidenced by the contradictions inherent in the present global economic order. "The rich nations must consume and waste on an ever increasing scale to keep the economy going .... Yet the planet cannot tolerate the consequences ..." (4).

The economic world view guiding the behaviour of industrial society is being challenged by an ecological world view, emphasising the limits to resource consumption in a finite world, and is even under attack from economists themselves: "Increasingly, people within the profession are looking for the causes of the failure of economics to solve the basic problem of allocation of scarce goods within a democratic framework, to deal with the questions of absolute scarcity (or even to recognize its existence), and to face up to the constraints under which any economic system must operate" (5)[1]. According to Henderson (1978) the 'bankruptcy' facing economics is also being felt in other professions; the continuing crisis in economics is accompanied by crises in sociology, psychology and even physics.

The environmental crisis, therefore, involves a profound subversion of the historical 'way of seeing' and organization

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1. These include such 'rebels' as Galbraith, Daly, Boulding, Georgescu-Roegen, Mishan and Benoit.

of knowledge within industrial society.

Knelman (1978) believes that a stage has been reached where the industrial world view is "beset by anomalies, dilemmas, paradoxes and contradictions which it can no longer ignore or cast off". Under these circumstances, the world is ripe for a *paradigm shift*, "a new vision which resolves these anomalies" (6).

In the following chapters we look at the concept of paradigms and how they change. The transition to a steady state is treated as a dialectic process, arising out of the conflict of two fundamentally contradictory world views:
a) the Technocratic paradigm of industrial society, and
b) the emerging Organic paradigm of a post-industrial world.

THE NATURE OF SOCIAL PARADIGMS

THE NATURE OF SOCIAL PARADIGMS

The word 'paradigm' has come into vogue in recent times, which perhaps in itself reflects the process of an adjustment in world view described by T.S. Kuhn in his book *The Structure of Scientific Revolutions*.

From his study of the history of science, Kuhn discovered a pattern of scientific revolutions which he identified as "those non-cumulative, developmental episodes in which an older paradigm is replaced in whole or in part with an incompatible new one".

A paradigm is usually understood to mean a frame of reference which influences the way an individual or a group of people look at and interpret the world around them. It is more than what people see; it is how they look. When this way of seeing, or world view, is shared by a community it becomes an explanation of reality and a system of shared values and beliefs develops around it[1].

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1. The word paradigm has come to have a number of different meanings. Masterman (1970) has identified 21 versions of Kuhn's use of the word. She organizes these meanings into three main groups:
   i) Metaphysical paradigms - which involve a set of beliefs, myths or metaphysical speculation and can be a way of seeing or an organizing principle governing seeing, a kind of map which determines the area of reality.
   ii) Sociological paradigms - these represent universally recognised social achievements, or a set of political institutions or an accepted judicial decision, and
   iii) Artefact or construct paradigms - which form the basis of a work or textbook, or can be seen as an analogy or a gestalt.

According to Kuhn, an anomaly occurs when nature violates the paradigm-induced expectations governing normal science. The acknowledgement of anomalies constitutes a novelty, i.e. it is accepted that something has 'gone wrong'. The term 'discovery' is used when these anomalies become expected and explored during the puzzle-solving process.

However, anomalies may become a source of trouble when the prevailing paradigm reaches a point where it persistently fails to solve its puzzles, and a paradigm crisis occurs. This leads to a period of Extraordinary Science in which the problems, solutions and methodologies of the earlier paradigm are less strictly adhered to and it becomes increasingly blurred. During a crisis a sense of malfunction develops which causes confusion and professional insecurity.

The transition to a new paradigm often involves a fierce debate in which a number of competing schools of thought emerge, each partially successful in explaining the anomaly. These groups become increasingly incompatible as they develop conflicting definitions of what constitutes a valid problem, solution or methodology. Each uses its own paradigm to argue its defence and discredit its opponents and the language of the competing techniques becomes mutually incomprehensible. At this point, says Kuhn, there is generally a recourse to philosophical and non-technical factors; the debate becomes one of fundamentals.

The paradigm crisis is solved when one candidate succeeds over the others and is most widely accepted by the community. This conversion may occur more as a shift in gestalt rather than on the basis of an argued proof. Conversion involves the simultaneous rejection of one paradigm and the adoption of another. A scientific revolution is therefore both a destructive and a constructive process.

At the next stage, the new paradigm is further articulated and developed. New theories, concepts, language and tools emerge and, as the old world view is abandoned, stubborn adherents either become converted or disappear from the community.

The winning paradigm is accepted as the most accurate description of reality but it need not (and in fact it never does) solve all the problems with which it is confronted. According to Kuhn, it is sufficiently open ended to leave all kinds or problems for its adherents to solve. Following a scientific revolution, the new paradigm becomes Normal Science; the community forgets about fundamental questions and becomes preoccupied with puzzle solving within a new framework.

Sociologists have come to recognise that paradigms not only guide scientific research but help members of all communities define social, economic and political reality.

The collection of norms, beliefs, values, habits and survival rules that provide a frame of reference within a culture is called a Dominant Social Paradigm (DSP) (1).

Ophuls (1977) explains that social paradigms consist of an ensemble of institutions, practices and beliefs which have a high degree of intellectual, emotional, moral and practical coherence and thus, like scientific paradigms, are difficult to change. "Retooling the paradigm is 'unthinkable' and is likely to be resisted to the bitter end ..."(2). So long as the basic theories of the paradigm can solve puzzles thrown up by Nature, all is well. When disturbing anomalies resist all efforts to incorporate them into normal theory, answers are sought outside the old framework and the society is ready for a paradigm revolution.

Pirages (1978) states that "a dominant social paradigm, then, is the predominant world view, model or frame of reference through which individuals, or collectively a society, gives meaning to the world". A DSP defines the nature of both the physical and social world, indicates problems and outlines the range of acceptable solutions to these problems. "It also defines the 'is' and the 'ought' in society or rules of social survival and social ethics" (3).

According to Pirages, a DSP represents a mental image of reality that forms social expectations. (This is similar to Boulding's concept of an image guiding the behaviour of a system, as outlined in Chapter 2.) Dominant social paradigms are passed down from generation to generation through socialization and education processes and are essential to social stability.

Drengsen (1980) has written that dominant social paradigms can also be regarded as forms of mythic under-

standing. Human beings organize and orient their lives in terms of various ideals, models, symbols and metaphors. A major function of myth, says Drengson, is to weave knowledge, aspirations and skills together in an inter-subjective realm of image and symbol. Mythic symbols can store and convey vast amounts of information in concise form. This makes it possible for a person to assimilate the collective experiences of their culture and for the society to perpetuate itself over time.

Thus, it is the nature of the cultural myth or paradigm which determines the relationship of individuals to their surroundings and the long term adaptivity of the society.

THE TECHNOCRATIC PARADIGM

1) INTRODUCTION

2) THE WESTERN TRADITION

3) A MASCULINE PHILOSOPHY

4) THE MODERN TECHNOCRACY

5) CONCLUSION

THE TECHNOCRATIC PARADIGM

1. INTRODUCTION

The paradigm which prevails in industrial society displays distinctive characteristics which generate an inherently technocratic (1) attitude towards the environment.

These include a preoccupation with economic growth and progress, or 'growthmania', which can be found "in most newspapers, magazines and between the ears of most businessmen, politicians and economists"(2).

Meadows (1973) states that "the concept of man held by advocates of indefinite growth is that Homo sapiens is a very special creature whose unique brain gives him not onl the capability but the right to exploit for his own short-term purposes all other creatures and all resources the world has to offer" (3). This attitude forms part of what Catton and Dunlap (1978) call a Human Exceptionalist Paradigm (HEP) which says that:

1) Humans are unique among earth's creatures,
2) Culture can vary almost infinitely and can change more rapidly than biological traits,
3) Thus, many human differences are socially induced rather than inborn, they can be socially altered and inconvenient differences can be eliminated,

4) Thus, cultural accumulation means that progress can continue without limit, making all social problems ultimately soluble.

Following these premises comes a set of economic and technologica beliefs which say that ultimately human satisfaction lies in the consumption of scarce resources, it is reasonable to allow economic values to predominate over social values, human destiny is to control nature and that the principle function of knowledge is to generate the technolo to do so. (4)

Recalling the means-end spectrum in Chapter 1, it can be seen that the technocratic paradigm is based primarily on an economic view of nature and is concerned exclusively with the means of production rather than with questions about its purpose or ends.

Daly (1973) writes that it focuses not on the distribution of wealth but on maximum 'want satisfaction'; it assumes that pure competition will achieve an optimal allocation, and that increasing the quantity of production (GNP) will produce a bigger economic pie from which wealth will 'trickle down' to make everyone better off. Because wants are 'infinite' they are best served by making production infinite. Finally, the way out of any growth-induced problems is the application of technology.

Ophuls labels the technology used in industrial society a 'Bulldozer Technology' which is characterized by:

- dependence on fossil fuels and other non-renewable or man-made resources,
- a dominating scale,
- a narrow concept of rationality and efficiency, and
- a linear way of thinking which fails to integrate with natural processes.

Ophuls finds the bulldozer an apt metaphor because of its violent power and the single-minded way in which it shapes nature to man's design (5).

These images of Man and of Nature are deeply ingrained in industrial society. To understand them more fully, however, it is necessary to take an historical overview and to explore the cultural and psychological influences behind them. This chapter traces the development of the technocratic paradigm from the emergence of the scientific world view in the seventeenth century. Western concepts of progress and knowledge are analysed in terms of a need to control Nature - to impose Man's order on the perceived disorder of his surroundings. This has occurred within a distinctively masculine philosophy which has mythed Nature as feminine and therefore separate and inferior to Culture.

The contradictions in this dualism are now maturing and, it is concluded, Technocratic Man must now confront the meaning of a human existence within the bounds of a finite planet.

2. THE WESTERN TRADITION

Clarence Glacken, in his major work *Traces on the Rhodian Shore* found that the conceptions of Nature in historical Western thought were characterized by "a yearning for purpose and order" and were part of a sense of continuous interaction between Man and his environment, in which he was both affecting and affected by his surroundings.

At the time of the Ionian philosophers, writes Glacken, it was perceived that order was generated by a struggle of opposites:

> "... 'out of those things whence is the generation for existing things, into these again does their destruction take place...'
> The interaction of these opposites - the coldness of air or mist and the heat of fire, the dryness of earth and the wetness of water - 'provides the clue to the process whereby an ordered world comes out of boundless unity'" (6).

However, by the Hellenistic age a fundamentally different perception had arisen. Glacken believes that with the rise of the Hellenistic cities came a new sense of human superiority and the alienation of Man from Nature. It was at this time, rather than during the clearance of forests in the Middle Ages, or the eighteenth century "ordering of nature", or even in the Industrial Revolution, that the roots of the modern attitude toward nature are to be found (7).

At the centre of the Western world view lies an inherent dualism, based on the separation and conflict between archetypal opposites such as order and disorder, Man and

Nature or culture and nature and, at a most intrinsic level, between male and female. What distinguishes this view from that of other traditions (for example, those of the East), is the suppression and control of one principle by the other, rather than the harmonious interaction of the two.

Thus, the Western tradition is characterized by dualism, hierarchy and fragmentation rather than by oneness, egalitarianism and wholeness (Holism). It is essentially linear and Masculine and in opposition to that which is cyclic and Feminine.

White (1974) has shown that in the pre-Christian era, the ancient West had a cyclical notion of time, without a linear concept of creation and Man, in God's image, dominating nature. Pagan animism believed that every tree, every stream, every hill had its own 'guardian spirit' which had to be placated before Man interfered. However with the advent of Christianity, says White, spirits in natural objects on the earth were no longer recognised. Spirituality was now located at a much higher level; the earth was seen as a habitat planned and designed by God. In what Glacken calls the "design argument", Christianity focused on the Creator, the created and that which bound them together. The dominant idea was of Man, blessed with the faculty of work, assisting God and himself in the improvement of the earthly home. This shift was to be accompanied by the development of the study of nature, which originally sought to achieve a greater

understanding of God through a knowledge of his creation. However, by the later Middle Ages, scientific study had achieved a certain independence and was being conducted more for its own sake. White considers that by the seventeenth century a major transition had occurred; the motivation for increasing knowledge was now predominantly secular. The idea of Man as improver of Nature led to an emphasis on achievement by mind, manual skill and knowledge. When this scientific world view was eventually fused with technology, it was found that knowledge of nature also conferred a power to control her forces (8).

What had happened over this time was an essential separation in which the spiritual elements, originally at home within the animals and plants on the earth, had been removed. Nature, devoid of purpose and mystery, had become the subject of human will; she was now to be exposed and explored by Man. Moreover, Man's exploration, his quest for greater knowledge, was now divorced from its former religious constraints(1). Science was free to devote itself not to the glory of God but to the glory of human achievement.

Moncrief (1970), in his criticism of White's argument for an essentially Judaeo-Christian basis for the environ-

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1. It is worth recalling Daly's hierarchical scale from Chapter 1: the Ultimate Spiritual Ends have been separated and polarized from the Ultimate Natural elements. Daly has recognized the tyranny of means or technique in the modern view, but continues with the dualism : Nature as "Ultimate Means".

mental crisis, points to a number of cultural factors which, he believes, were just as important as religious factors. In particular, he speaks of a certain egocentricism in the West which was accompanied by an hierarchical organization of social relationships, and a universal desire for achievement and 'a better life'.

These attitudes were undoubtedly formed in large part following successes in the development of agriculture, drainage and engineering (9). Human self-confidence was further expanded during the Age of Exploration, in which the discovery of new lands and different peoples led to "an overthrowing of older opinions and in broadening men's horizons" (10). By the eighteenth century, it was realized that the world was more plentiful than had been imagined and, after observation of the ways of 'primitive' societies, that if a civilization was to advance it was necessary to change the natural order (11).

Taken together, the preceding comments point to a parallel development in the West of an increased ability to control the natural world (erecting buildings / 'culture') and a sense of human uniqueness and mastery over it. As human power increased (i.e. the use of energy), so too did the West develop a self-confident image of its superiority and prowess. Indeed, as Elizabeth Dodson Gray has written in her book *Green Paradise Lost*, the traditional genesis of Man's Fall from Grace[2] should really have been described as a

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2. "Grace" can be understood to mean the Garden, harmony, unity or perfection.

fall *upwards* - at least that is the illusion which has been maintained within the Western tradition.

In what Gray calls a "cosmological pyramid", God is perceived at the apex, as pure spirit, and just below God comes Man. Below Man comes Woman, then children and then nature. In the Genesis myth, writes Gray, "woman was created ... out of man's body (rather than from a woman's body as happens naturally). She was created to be a function in man's life ... to define her existence in relation to him by being a 'helpmate' to him. Then came children, so derivative that they are not even in the Creation Story. In this view children are obviously less 'spiritual' in their formative years and thus suitable for being below. Then come animals, who do not have unique spirit at all - and thus while they live and move about do not have 'Being' as humans do. Thus animals are below. Below them is the ground of nature itself - the hills and mountains, streams and valleys - which is the bottom of everything, just as the heavens, the moon, the stars are close to God at the top of everything" (12).

The higher up you went in this "three-storey view of the universe" the more spiritual you became. In the opposite direction (down), you moved toward the devil, hell and the underworld - the place of all that is fleshy, unspiritual and, by definition, evil (13).

The development of the scientific world view, from the seventeenth century, is clearly based on this cosmological inheritance. It began with the assumption that the growth of

knowledge (control-energy-information) would bring men closer to God (perfection-unity). But in effect, men came to see *themselves* as God-like, as their control and knowledge of Nature expanded:

> "To master nature was to upgrade the essence of man: as man progressed so the earth would be 'cultivated' to even greater perfection. Civilization was therefore regarded as the application of purposive order by which a pliable earth was moulded to satisfy human needs" (14).

Glacken found this attitude fully in evidence in the writings of Ficino, Paracelsus and Francis Bacon. According to Ficino:

> "[Man] imitates all the works of the divine nature, and perfects, corrects and improves the work of lower nature. Therefore, the power of man is almost similar to that of divine nature" (15).

With the growth of human power, Technological Man imagined himself above the creation and in charge of its workings. Thus, there emerged a clear philosophy of a never ending upward progression, in which Man, through his achievements, was to become more magnificent and more powerful. Having banished God from the earth (after six days work He was now the 'Retired Engineer', in heaven - (Easlea, 1980)) Man was now at the controls of the ship, and steering a straight-line course, onwards and upwards, to greater success and even greater glory.

In his *Hymn to Science*, Fontanelle (1699) is clearly aiming for the stars:

> "The application of science to nature will constantly grow in scope and intensity and we shall go on from one marvel to another; the day will come when man will be able to fly by fitting wings to

> keep him in the air; the art will increase more and more until one day we shall be able to fly to the moon" (16).

And indeed he did. But the profound irony of the space flights in the 1960s was that rather than releasing Man from the bounds of the Earth, a spaceship view of the world showed how truly he depended upon it.

Norman Cousins has written that "the real meaning of the human expedition to the moon, if it is read correctly, is that the conditions required to sustain human life are so rare in the universe as to constitute the greatest achievement of creation". And yet, Cousins goes on, the "prime beneficiaries of this bounty are now engaged in converting their habitat into a wasteland not less uncongenial to life than the surface of the moon. The biggest challenge of all, therefore, is to prove that intelligent life can exist on earth". (17)

It is worth recalling at this point the remarks of Garrett Hardin in Chapter 1, who reminds us that today the new frontier does not lie in outer space but rather in our 'head space'. Thus, if we wish to achieve an understanding of how man's self-image has developed, it will be necessary to explore some of the psychological roots of the technocratic paradigm.

3. A MASCULINE PHILOSOPHY

As Gray has shown, the Western tradition has been dominated by a hierarchical paradigm which insists on a comparative ranking of that which is Up (superior, spiritual

or closer to perfection) and that which is Down (inferior, carnal or closer to the chaos of Hell). What is important here is that this ordering is an essentially Masculine perception, which sees that which is different (women, children, primitive people, nature) as Other - as separate and below (18). From this vision of reality flow the familiar philosophical dualisms such as animate/inanimate, mind/body, spirit/flesh, and culture or civilization/nature.

All of the great scientific and technological achievements of the West, says Gray, are predicated on this confidence that Man (in effect men) is truly "above", that he "calls the tune" and that which is below will constantly be compliant and adapt. Man is the great Doer - Woman and Nature are the Done-To. Thus "the lower orders - whether female or child or animal or plant - can be treated, mistreated, violated, sold, sacrificed or killed at the convenience of the higher states of spiritual being found in males and God" (19).

This sense of Other is also manifested in Western semantic structures, as evidenced by verb/noun, observer/observed, subjective/objective speech conventions (20).

A binary form was also recognized by Arnoux (1981) in his analysis of attitudes in group discussions about energy development issues. What emerged was a profound sense of 'they' (the powers, decision makers or masters) and 'us' (the powerless, ordinary people). In this "metadiscourse", it was found that 'they' acted upon and defined 'us' by what

'they' were doing to 'us'. Arnoux's response was to describe this as a kind of one/zero pattern which generates a polarity on two sides of a bar: that 'which-is' defines the Other side. Similarly, Thompson (1969) talks about the subject-predicate bifurcation of sentence structure in West European language which separates noun from verb, actor from action, form from foundation. "This linguistic peculiarity helps to condition us to the two-fold seeing of experience ... our traditional division of matter from mind" (21).

The severing of connection with the Other has occurred at the most fundamental level in the dualism of Man/Nature. Further work by Arnoux (1981) has shown that even environmentalis display a sense of 'the environment' being 'out there' and 'around us' while, at the same time, insisting that Man is 'part of the environment'. Caldwell (1971) makes a fine example when he writes that "... man, like all other living creatures, is both part and product of his own environment. His very existence is absolutely dependent upon certain minimal environmental conditions such as oxygen and food, temperature and humidity. *As an animal* he tends to accept his environment as a fish accepts his aqueous medium: he takes it for granted. *As a man*, however, he is capable of *objectifying his environment*, he can *conceptualize it as separate from himself* and can *imagine* himself as separate from it" (emphasis added).(22)

For Caldwell, Man is 'he', and 'he' has the power to 'objectify' and 'conceptualize' Nature as an 'it', which

belongs to him. Yet 'he' does not belong, he can only 'imagine' himself. With such a deep fragmentation, Self becomes an image, and an illusion; reality a contradiction and a "sham" (23). Man, devoid of a sense of place, is empty of a sense of Self. Is it no wonder then, that such a creature would find the earthly home so unsatisfying and would feel the need to take flight from his anxiety and confusion - and thereby avoid a confrontation with the meaning of his existence?(1)

The Masculine response to the threat of finitude - to the meaning of being born but having to die - has in the West been channelled into an urge to act as God, to be above and in control(2).

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1. It is interesting to think of the recent boom in 'space age' entertainment from this perspective - largely a return to the glories of the 1960s when Men, "going where no man had ever gone before", conquered "the last frontier". This endless "Star Trek" (we are never quite sure where to) is filled with high adventure. "Star Wars", reminiscent of all the famous past battles (World War II, the development of America's West, even the battle of the sexes), are refought in dramatic technicoloure confusion. No one really wins - the enemy eventually returns to "Strike Back" - and Man is still "Lost in Space".

2. Recall here the characteristics of pioneer communities from Chapter 2 and reflect, too, upon the 'cult of youth' in the imagery of industrial society.

An eye-of-God view of the world makes it possible for him to separate himself from Nature (to objectify), and to define his meaning (his 'way of being' - place, self) by increasing his design or ordering of her.

This 'way of knowing' Nature is the subject of an important book by Brian Easlea (1980), *Witch-hunting, Magic and the New Philosophy*. Easlea makes a strong connection between the development of science in the seventeenth and eighteenth centuries and the power of men in the ruling and privileged classes of Western Europe. For it was these men - Bacon, Descartes, Newton - whose ideas form the groundwork of the Technocratic Paradigm.

The natural philosophy of the Royal Society, says Easlea was an inherently Masculine Philosophy which valued facts and deeds over words and sought to dominate the world of matter - perceived always as feminine. "God's great pregnant automat on - as Boyle called nature - will thereby come under man's control". For the scientists, says Easlea, there could be no greater male triumph than "to know the ways of captivating Nature and making her subserve our purposes" (24).

Nature, we recall, was identified with disorder, darkness and those deep things which were below the ordered realm of Man. Nature was unpredictable and hostile. Being not only at the bottom of Man's cosmological pyramid "but being the most full of dirt, blood and such nasty natural surprises as earthquakes, floods and bad storms" she was obviously "a prize candidate for the most ruthless 'mastering' of all" (19).

This "threat" provoked what Easlea calls an almost overwhelming display of confidence by male members of ruling classes "in their ability to control events and in their obsessive desire to impose such control". Nature was to be mechanically appropriated: "the course of nature ... must be regular and orderly and in no way whimsical or capricious so that causes of effects can be identified and reproduced at will. Secondly, no interference in the (regular) course of events must be allowed that is not sanctioned or commanded by the ruling (male) elite ..." (25). Under the rule of Science, Nature was to be known (in a truly biblical sense) by force of will.

Perhaps one of the most influential figures of this time was Francis Bacon, who rejected the Aristotelian world view in favour of a distinctly more vigorous approach to Nature. The earlier philosophers, jeered Bacon, had been content merely to contemplate Nature, "never to lay hold of her and capture her". Dissipating his energies in useless contemplation, Aristotle had "left nature herself untouched and inviolate" (26).

Looking at Bacon's attitudes, there can be no mistake that "science was a masculine quest and the earth was female" (27). The true sons of science, said Bacon, would aspire to overcome nature in action, "that passing by the outer courts of nature, which others have trodden, we may find a way at length to her inner chambers" (26). Bacon appealed to men to battle against nature, "to storm and occupy

her castles and strongholds" (27). This would inaugurate the "truly masculine birth of time", the new era in which man would increasingly gain the power to "conquer and subdue [nature], to shake her to her foundations" (28).

4. THE MODERN TECHNOCRACY

This imagery - of buildings and the use of power - reflects the intrinsically mechanistic character of the technocratic paradigm. Reality is perceived in terms of constructs and ordered units, an approach which Drengson (1980) traces to the methods of Descartes.

The Cartesian technique of inquiry was grounded in a view that the proper application of the right technique would yield solutions to any problem. It emphasised the uniformity of both method and the character of problems. Drengson writes that its aim was to reduce natural phenomena to their component parts, to explain all wholes by reference to their parts and to their external, measurable relationships. This was also applied to thought processes - ideas could be reduced to their simplest parts and new ideas would result from new combinations. Thus "the whole world begins to look like a complex machine" (29).

However, as Drengson points out, Descartes did believe that living creatures, other than Man, with soul could have significant intrinsic value. But once this view was rejected by the naturalist philosophers, the technocracy was impoverished in fundamental questions or ends, and was free

to emphasise methods and means. For those who kept only the materialistic half of the Cartesian dualism, the emphasis was upon "method and technique, upon reductionism, upon explaining all natural phenomena in mechanistic terms, [and] the quantification of as much of the Natural world as possible" (30).

The modern technocracy strives to create a perfect 'machine order' at all levels of society. Ellul (1964) has written that "technique integrates the machine into society. It constructs the kind of world the machine needs ..." by adapting people to mechanization. Technique clarifies, arranges and rationalizes; it is efficient, and brings efficiency to everything by applying the 'best method'.

Thus, the material, i.e. technical, substratum of human existence, which was traditionally not allowed to be a legitimate end of human action, has become so enormous and so immense that people are no longer able to cope with it as means, so that it has become an end in itself. "It is the essence of technique to compel the qualitative to become quantitative and in this way to force every stage of human activity and man (sic) himself to submit to its mathematical calculations" (31).

Ellul identifies three principal subdivisions of modern technique, in addition to the purely mechanical:

1) The economic technique - which is almost entirely subordinated to production and ranges from the organization of labour to economic planning,

2) The technique of organization - which concerns the great masses, and applies not only to commercial and industrial affairs but also to states and to administration, police power, warfare and the legal field, and

3) Human technique - where people become the object of technique in all spheres from medicine and genetics to propaganda.

Technique takes over all the traditional and natural rhythms of human life:

> "Genuine human communities are suppressed by the technological society to form collectivities of mass men, incapable of obeying any other law than the statistical law of large numbers. All the technical devices of education, propaganda, amusement, sport and religion are modified to persuade the human being to be satisfied with his condition of mechanical, mindless 'mass men' and ruthlessly to exterminate the deviant and the idiosyncratic" (32).

Human spontaneity is suppressed as the traditional creative outlets of human expression - art, literature - become neutralized by technique. Technique takes over craft and intervenes even in human consciousness. The technician takes stock of alternatives and will apply the 'best method' in fields which traditionally "have been left to chance, pragmatism and instinct".

Ellul discusses four characteristics of modern technique:

1) The automatism of technical choice. Technique aims always for 'the one best way':

> "When everything has been measured and calculated mathematically so that the method which has been decided upon is satisfactory from the rational point of view, and when, from the practical point of view, the method is manifestly the most efficient of all those hitherto employed or those in competition with it, then the technical movement becomes self-directing" (33).

Technical automatism must not be impeded; "... what can be produced, must be produced. If a machine can yield a given result, it must be used to capacity" (34).

2) Self-augmentation. Technique has evolved to a point that it is progressing without human intervention:

> "Modern men are so enthusiastic about technique, so assured of its superiority, so immersed in the technical milieu, that without exception they are oriented toward technical progress. They all work at it, and in every profession or trade everyone seeks to introduce technical improvements. Essentially technique progresses as a result of this common effort." (35)

In addition, says Ellul, there is an automatic growth of everything which concerns technique. When a new technical form appears, it makes possible and conditions a number of others. He concludes that "on the whole, it is the principle of the combination of techniques which causes self-augmentation". The growth of technical progress in a given civilization is irreversible and tends to act in geometric progression.

Finally, technique poses primarily technical problems, which can only be resolved by technique. Consequently the individual's role becomes less and less important. "In this decisive evolution, the human being does not play a part. Technical elements combine among themselves and they do so more and more spontaneously" (36).

Thus 3), technique takes on its own reality; it has its own means and ends, its own morality. "The technical phenomenon, embracing all the separate techniques, forms a whole", a monism (37).

Technique comes to master all the elements of a civilization - such that it is "constructed by technique (makes a part of civilization only what belongs to technique), for technique (in that everything ... must serve a technical end), and is exclusively technique (in that it excludes whatever is not technique or reduces it to technical form)" (38). Without exception, says Ellul, in the course of history, technique *belonged* to a civilization, along with other non-technical elements. Today, technique has taken over the whole of civilization.

4) Therefore, technique becomes autonomous - it elicits and conditions social, economic and political change and is no longer influenced by external necessities. It has become the judge of morality - it puts itself beyond good and evil and so "in itself is neither, and can therefore do what it will" (39).

Within society says Ellul, technique is our universal language. "It is the fruit of specialization. But this very specialization prevents mutual understanding" between people. It has "cut the umbilical cord" which linked people with each other and with nature.

People, divided into specialized roles, no longer understand the vocabulary of their neighbours. They must

communicate using the technique-inspired signs with which they label their compartmentalized surroundings (40). Technique as language is universal and can be communicated across beliefs or races; it creates a new bond which "compensates for all the deficiencies and separations it has itself produced" (41).

Technique excludes the symbolic and the mysterious. It desacralizes the environment - "it worships nothing, it respects nothing. It has a single purpose; to strip off externals, to bring everything to light, and by rational use transform everything to means. More than science, which emphasises 'the how', technique desacralizes because it demonstrates that mystery does not exist: Science brings to the light of day everything man had believed sacred. Technique takes possession of it and enslaves it" (42). As a result, says Ellul, the individual who lives in a technical milieu transfers their sense of the sacred to the very thing which has destroyed its former object: to technique itself. "Technique has become the essential mystery" (43).

5. CONCLUSION

In this chapter I have attempted to demonstrate that the predominant world view which has allowed industrial society to expand beyond the limits of the biosphere is inherently technocratic, in that it aims to control Nature.

It is interesting to see that although Ellul was writing from a 'social' rather than an 'environmental' stance, he did

emphasise how important control was to the technocracy: "Everything, for technique, is centered on the concept of order" (44). He remarks that "for a long time it was believed that technique would yield a harmonious society, a society in equilibrium, happy and without special problems". However, it had been forgotten "that technique means not comfort but *power*" (emphasis added) (45). According to Ellul, there can be no distinction made between technique and its use. "Everything which is technique is necessarily used as soon as it is available, without distinction of good or evil" (46). Or, as he quotes Jacques Soustelle, in reference to the atomic bomb, "Since it was possible, it was necessary".

In the desire for the perfection of technical methods, the objective of control - to reach a pure technique - dominates more and more. The highest value today is order and, to achieve it, the technocracy seeks to eliminate all sources of irregularity. Indeed, the entire history of human development, which has culminated in the modern industrial technocracy, has been process of increasing order and control by using power - over Nature and over people.

By way of conclusion, I want to suggest that this has resulted from the predominance of the 'masculine principle' in human affairs, which has produced an imbalance in the relationship people have with each other and with the planet.

Over human history, Nature has been perceived as an ever present source of disorder and hostility. She was

unpredictable and unfathomable. Man could not know how she 'operated' or how he 'fitted in' - where he came from and where he was to go when he died.

Man felt apart from this Other and threatened and so his reaction was to try to control his surroundings. His way of knowing - interacting with the world - was to reduce Nature to manageable proportions and destroy her mystery.

Nature was associated with life and death, the cyclic processes of reproduction and decay. Nature - as Mother Earth - gave birth to all living things, and took them back when they were finished.

Man's response to this awesome creative potency was to take over the power of creation, to see *himself* as the Creator. Thus in the Genesis myth - written by a man - God is a male and men are made in the image of God, from whom Woman/Nature is created[1].

Over time, Man's creative powers expanded as he developed and took over the natural world:

> "... as civilization advances, clearing and draining goes on, towns are born, castles rise on the hills. Earth-works and dams control the water. Man finishes the creation. Gradually ... the earth has been so changed from its original state it can now be called another earth" (47).

With the development of science, the control of Nature would extend even further. For example, Easlea quotes

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1. This is in contrast to the creation myths of other cultures, in which there are two parents (as happens naturally!) who unite to produce the world; a Rangi and a Papa.

Humphry Davy of the Royal Society, who wrote that the man of science, not content with what is found on the surface of the earth "has penetrated into her bosom.... for the purpose of allaying the restlessness of his desires or of extending and increasing his power". Science had bestowed Man with creative powers which have enabled him "to interrogate nature with power not simply as a scholar, passive and seeking only to understand her operations, but rather as a master, active with his own instruments" (48). All the things on earth had been given into the hands of Man, so that he could "bring them to the highest order of development, just as the earth does with all that it brings forth" (49).

Man's fear of the creative potency of Nature also involved a fear of death and decay, which of course called his own mortality into question. The response was to avoid thinking about the cycles of life, the problem of life after death, and to concentrate on a 'straight-line' vision of the glories which Man could achieve on the earth in the present. George Perkins Marsh, for example, wrote in *Man and Nature* (1864):

> "Wild nature is hideous and dying; it is I, and I alone, who can make it agreeable and living."

He advocated drying out marshes, building canals and clearing forests to make way for pastures and arable fields, so that "a new nature can come forth from our hands" (50).

The fear of reproductive potency was, naturally, also directed towards women. The Female, as we have seen, was identified with all that was dark and powerful and carnal -

the world of fleshiness and evil. Thus, women in early Christian times were defined as lascivious and of the devil. Rosemary Reuther (1976) explains:

> "the Church Fathers ... defined men and women along the lines of mind and body. But because they also saw the body as an evil and demonic principle and defined salvation as the suppression of bodily feelings, women came to be seen as special incarnations of evil or 'carnality'. The flight from the body and the world became specifically the flight from woman ..." (51).

Reuther goes on to say that this produced a split image of the feminine in Christianity - of spirituality symbolized by the Virgin Mary on one hand, and of carnal femaleness on the other. She concludes that: "it can hardly be a coincidence that the same period that saw Mariology reach the greatest heights of theological definition ... also saw the outbreak of witch hunts that took the lives of upwards of one million women in the 14th and 17th centuries" (52).

By the machine age however, female sexuality had been re-mythed. Nature under the control of Man was denied her procreative power; Man, although he could not reproduce, was now the producer.

The modern age, as we have seen, has been an era of phenomenal energy use, as Technological Man has been busy re-building and re-arranging the world. As Dasmann (1976) writes, "productivity in the mechanical rather than the biological sense is a principal activity of a technocracy" (53).

Man need no longer fear female potency, because he was now in charge of creation. Thus women could be re-

mythed as sexless. According to Easlea, with the advent of the Reformation, capitalism and (male) medical pronouncements, women were pronounced as not only passive but passionless:

> "Mechanical philosophers not merely all but banished life from the cosmos, but minimized the role of women in procreation, declared nature incapable of giving rise to life and proclaimed matter itself to be inert and passive, possessing therefore the *ideal* female qualities" (emphasis in original) (54).

The people doing the mything were of course men. Easlea notes further, that they were the powerful men in society:

> "Men of the ruling classes prided themselves on their possession of mind, on their pre-eminence in the faculty of reason. [Thus] the labouring classes were relegated to the status of matter or raw materials to be put to use by those superior to them ... [and] men claimed the right to rule over women because of supposed male predominance of intellect". (55).

Easlea also makes a case for modern racial attitudes being based on the fear, of these same men, of perceived Negro sexual potency.

Thus women, nature and black people have been defined as carnal and inferior to white, upper class males, who were rational and intellectual. "Mind over matter" legitimated class, race and sexual inequalities.

The final culmination of the suppression of 'earthiness' or animalism in the Other, was for men to deny this more 'feminine' side in themselves - in their bodies and in their minds.

For the natural philosophers, remarks Easlea, sexuality was to be feared, and the sexual act came to be regarded as undignified, 'bestial' and, worst of all, irrational. Man

was objective and above emotion. The feminine way of knowing was to be suppressed not only through the suppression of the Other, but also within himself.

As Easlea concludes, this produced a Western bourgeois man, made in the image of God the Father, who having chosen to "cut himself adrift from 'Mother Earth' had therefore left himself with no alternative but to appropriate the physical world - God's great automaton - mechanically and asexually" (56). The only means of proving his masculinity and virility lay in the compulsive and "ever-developing *technological* appropriation of a passive earth, so that men might achieve, in Francis Bacon's momentous words, 'the effecting of all things possible'" (emphasis added) (57).

The perfection of Technological Man could only be the next step. Having subdued Nature, the modern technocracy must strive to subdue 'human nature' - i.e. that which is natural remaining in people. The spontaneous, the rhythmic and the cyclic elements of human existence would be brought under the clock-like control of the technocracy; and thus, as Jung tells us, the symbolic and the unconscious would be repressed and denied (58).

Ellul explains that because people are variable and susceptible to emotion, fatigue and discouragement, they tend to disturb "the forward thrust of technique". Human joys and sorrows are fetters on technical aptitude. Therefore this "imprecision" has given birth to a new range of human sciences whose aim is to adapt people to the

exigences of a technological life. Outbursts of human spontaneity can be channelled through the techniques of mass entertainment or mass sport.

The perfected technological society can perpetuate itself through "the illusion of liberty, choice and individuality" (59).

Once people have been totally integrated by technique, even if they come face-to-face with the perfectly functioning machine world, they no longer have the human initiative or desire to escape. "The ability to forget the machine is the ideal of technical perfection" (60).

The complete expression of the Masculine principle has led to the 'perfection' of technique, but at the same time, to a complete denial of human Self. Technological Man is a masculine creation, but *human beings* exist because of the interaction between both principles - the Masculine and the Feminine.

The fact that Ellul and others can write about "Technique" is sufficient evidence that they have not been perfectly integrated, so as to forget their Self. The reaction of technique to such aberrations (or anomalies) is usually to treat them as a "friction" in the machine which can be defined as a problem and solved, with a 'technological fix'. I conclude, however, that the anomalies facing technique can no longer be resolved within it, because they are not 'technical problems'.

The environmental crisis has brought Technological Man to a confrontation, not only with the limits of the planet but also with the meaning of what it means to be human, on the planet.

There now exists a profound contradiction between the view of the Technocratic paradigm and the reality of the human environment.

In the next Chapter, it is suggested that the maturing of these contradicitons is generating a new anti-thesis to the technocratic thesis of increasing order and control.

THE EMERGING ORGANIC PARADIGM

1) INTRODUCTION

2) CHARACTERISTICS OF THE ORGANIC PARADIGM

3) THE SHE ALTERNATIVE

4) CONCLUSION

THE EMERGING ORGANIC PARADIGM

1) INTRODUCTION

Evidence is now growing that a new way of viewing the world is emerging, based on a rejection of the growth values of the technocratic paradigm, in favour of values which emphasise a humility towards nature and the importance of personal fulfilment over material accumulation.

These changes foreshadow what Pirages and others[1] describe as a third great revolution in human history, which will foster a world view as different from the present industrial paradigm as it was from its agrarian predecessor, and from which a post-industrial society may emerge.

2) CHARACTERISTICS OF THE ORGANIC PARADIGM

O'Riordan in his book *Environmentalism (1976)*, identifies the following features of the emerging paradigm:

1) It challenges features of almost every aspect of Western capitalistic culture[2],
2) It does not yet offer a clear cut alternative to the present dilemma but instead points out its paradoxes,
3) It is about a conviction that a better mode of existence is possible,

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1. Some of these writers are mentioned on page 68.
2. I would disagree and suggest 'industrial culture'.

4) It is a politicizing-reformist movement.

However, I consider that O'Riordan has underestimated the depth of the new paradigm - it not only has workable and working alternatives but it represents a true revolution or 'turning away' from the technocracy itself.

The new paradigm (which I have called 'organic' in contrast to the technocratic paradigm) represents an entirely new set of social values which are now apparent not just within the 'environmental movement', but right across industrial society.

Robertson (1978), for example, points to alternatives in employment, inner city living, agriculture, economics, technology, health, education and politics - new 'human growth' points, based on concepts of co-operative self-reliance and self-development. Similarly, Trist (1980) writes that the new 'cultural revolutions' which are taking place (for example in work, nutrition, materialism, womens' liberation,gentleness in men and women, pluralistic families) are becoming connected, as they are congruent. "They promise a change of values (emphasising collaboration and sharing, rather than competition and personal gains) and of lifestyles, which may indeed be turbulence-reducing and enable a post-industrial society to come into existence" (1).

These trends have become particularly obvious since the 1960s, when doubts about technocratic society gave birth to what Roszak (1969) called the 'counter-culture'. Falk (1972) describes it as a new lifestyle that:

> "... shuns careerism, that searches for communal forms of being together, that affirms more mystic modes of being and that has turned against the rational-scientific traditions of objective consciousness associated with the rise of the West" (2).

In essence, says Falk, it is "striving to protect human personality against the destructive tendencies at work in advanced industrial societies" (3).

The 'counter-culture' was part of a wider shift which has continued since the 1960s and can be seen in the development of ecological consciousness, the reassertion of black people, and of women, and in the growth of citizens' movements demanding greater corporate and government accountability. This re-assertion of the Other is associated with what Henderson (1978) calls the growing manifestation of "female social wisdom" or "body wisdom" - which involves a more organic way of knowing and being in the world.

These trends are not only felt in the political arena - the academic world too is undergoing change. For example, the physicist Bartlett (1978) insists that:

> "We must educate people to the critical urgency of abandoning our religious belief in the disastrous dogma that 'growth is good', that 'bigger is better', that 'we must grow or we will stagnate' etc. We must realize that growth is but an adolescent phase of life .... If [it] continues in the period of maturity it is called obesity or cancer. Prescribing growth as the cure of the Energy crisis has all the logic of prescribing increasing quantities of food as a remedy for obesity" (4).

Growth has also been rejected by sociologists. Catton and Dunlap, for example, in contrast to the conventional Human Exceptionalist view, identify a New Environmental Paradigm (NEP) which says that:

1) Human beings are but one species among the many that are interdependently involved in the biotic communities that shape our social life,
2) Intricate linkages of cause and effect and feedback in the web of Nature produce many unintended consequences of purposive human action, and
3) The world is finite - so there are potent physical and environmental limits constraining economic growth, social progress and other societal phenomena.

For Henderson - and others critical of conventional explanations "whose vision has remained unclouded by the economists' mystification" - it seems that the transition is obvious, that much of the 'retooling' has already begun and that it can be inferred from extremely simple metaphors such as 'There is no such thing as a free lunch', 'Nothing fails like success' or 'There is no away'.

Other 'key words' include sustainability, the conserver society, [w]holistic, unitary, organic, synergy and synthesis. Theologian Kenneth Cauthen (1976) says that the new focus is on "total systems, seen as a unity of dynamically interacting, mutually sustaining parts which work together to support the functions and goals of the whole unit" (5).

Knelman concludes that the "empirical and experiential failure of present growth societies is leading to a new convergence of intellectual and social forces around the need for 'appropriate development'" (6).

Thus, the world view of industrial society, its social structure and the language in which these are reflected, is being opposed by a new social paradigm in which personal growth is valued over material growth and technology is reduced to a 'human scale' (7).

3) THE S.H.E. ALTERNATIVE

In his book *The Sane Alternative,* Robertson (1978) recognises two contrasting views of a post-industrial society:

1) The Hyper-Expansionist (HE) -

This view aims for a super-industrial way of life based on high technology, computing and telecommunications. Many existing trends are accelerated - there is greater reliance on science and academic knowledge, greater specialization and institutionalization of social activities (e.g. welfare, entertainment and religion) and continuing emphasis on material growth:

> "The assumption is that if European, scientific, expansionist, economic, masculine man has the courage of his convictions, he will be able to brush aside (or at least bring under control) the political, social, and psychological problems, as well as the economic problems, that beset industrialized societies today" (8).

2) The opposing view, Robertson calls the Sane Humane Ecological or SHE future -

This view emphasises the importance of intuitive understanding and sharing personal relationships rather than elitist knowledge and the bureaucratic control of social life. It looks to decentralization: community politics

and direct, participatory democracy rather than representative government. A S.H.E. society would replace the present institutional economy based on money and jobs with a gift and barter economy of households and communities, which emphasised self-defined and self-fulfilling work roles.

In summary, Robertson writes that the emerging paradigm would put more emphasis on:

- the non-material as contrasted with the material
- the qualitative as contrasted with quantitative
- the intuitive and emotional as contrasted with the rational
- planetary culture as contrasted with European culture
- the feminine as contrasted with the masculine
- human involvement in the ecosystem as contrasted with human domination of nature.

O'Riordan (1976) believes that a shift from our predominantly patrist mode (restrictive, authoritarian, conservative, backward looking, unimaginative) to a more matrist mode (permissive, egalitarian, democratic, optimistic, future oriented and spontaneous) will in turn "promote the formation of the 'soft' ego of group consciousness and altruism" (9). It would mean a new environmental morality based on the virtues of restraint, stewardship, humility or reverence, and holism (10).

4. CONCLUSION

It is important to note that both Robertson and O'Riordan call for *more* of the feminine principle, rather than its complete expression. The organic paradigm does not demand the rejection of the technocratic for a tyranny of the Other. Instead it involves a more equilibrating relationship between the two principles - a goal of harmony and balance rather than of dominance and subservience.

However, the emergence of the organic paradigm represents a deep threat to the prevailing technocracy and so it will be strenuously resisted by HE thinking people. Indeed, as Chapter 7 suggests, it is possible to observe a growing struggle between the two world views as they attempt to provide the best image of reality, i.e. the image with the highest potential to solve the problem of human survival.

THE DIALECTIC OF TRANSITION

THE DIALECTIC OF TRANSITION

1) INTRODUCTION

The transition to a post-industrial paradigm can be interpreted as a dialectic process in which the prevailing technocratic thesis is confronted by the contradictions it has generated - its antithesis - in the form of social and environmental breakdown.

The interaction of the two opposites takes the form of a struggle of world views which is producing an irreconcilable gap between the adherents to growth and those who are insisting on a new direction toward equilibrium.

The organic paradigm attempts to reconcile the behaviour of modern society with the finite limits of the biosphere, i.e. it represents a new synthesis between the *form* of the human system and the *information* of its environment, which may prove more appropriate for human survival.

2) THE STRUGGLE OF WORLD VIEWS

As it was suggested in Chapter 5, the development of technique in industrial society has proceeded to a point that rather than serving human ends, the means of technique have become an end in themselves. As a result, the goal of increasing order and control has now generated an uncontrollable level of disorder - both within human communities and the environment.

Harman (1977) describes this contradiction in terms of four basic dilemmas which now confront industrial society - the environmental and social costs of increased economic growth, the need for centralised social control over new technologies, the long term consequences of avoiding a distribution of wealth with less-developed societies and, finally, the need for jobs which also provide meaningful social roles.

These conflicts are all 'problems of success' - they represent the maturing of industrialism to a level of over-development which has generated a series of crises which may prove the seeds of its own destruction. Ellul, for example, notes that every new technique is matched by its negative or reverse side. The maturing of technique has led not only to its own rejection but also to the flowering of a new, organic paradigm.

As more and more people recognise the contradictions of industrialism a paradigm struggle is emerging. Thus, the implicit and repressed has become explicit and challenging. This stress has produced increasing levels of 'cognitive dissonance' (1) which mark what Caldwell predicts will be "an indefinite period of tension and conflict between the historical commitment to unfettered economic growth and the new growing concern for the quality of life" (2).

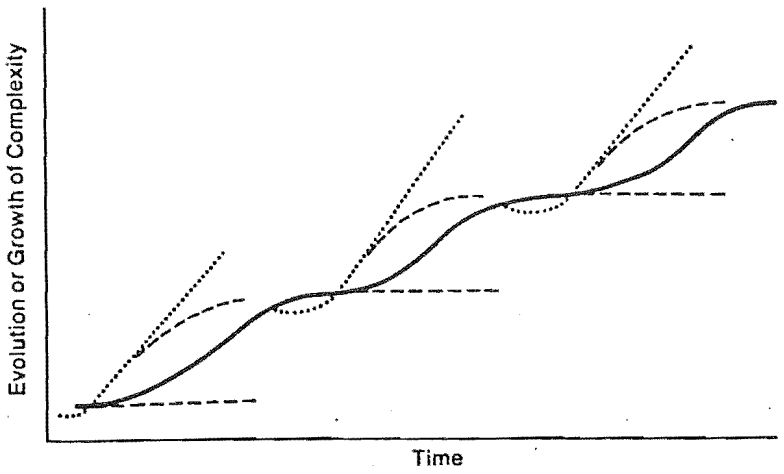
Herman Hesse has written:

> "Human life is reduced to real suffering, to hell when two ages, two cultures and religions overlap .... Now there are times when a whole generation is caught in this way, between two ages, two modes of life, with

> the consequence that it loses all power to understand itself and has no standard, no simple aquiescence" (3).

This confusion is inherently part of the adjustment lag described in Chapter 2, which occurs between the time that environmental constraints are encountered and when a new world view is born. In society, it produces an irreconcilable gap between "those who anticipate a continuation of present trends and those who insist that a drastic change must occur" (4).

Returning to Salk's diagram from Chapter 3, it will be recalled that the world view or image guiding the human system can be related to the position it holds on the sigmoid growth curve:



(Adapted from Salk 1973.) P.26

As the system develops, two opposing trends become apparent - the A curve aiming for further growth, and the B curve which seeks equilibrium. In the dialectic of cultural evolution, says Salk, growth leads to stability which in turn is displaced by an innovation, causing a new disequilibrium. These premature branches on the evolutionary tree often do not develop fully - yet they may be a necessary

prelude in the evolutionary process of selection amongst alternative events.

Salk believes that humanity is at the point of inflection and is under pressure to make a new selection. He is optimistic that there may be a reservoir of human potential appropriate to the 'B epoch' - and that it is now emerging:

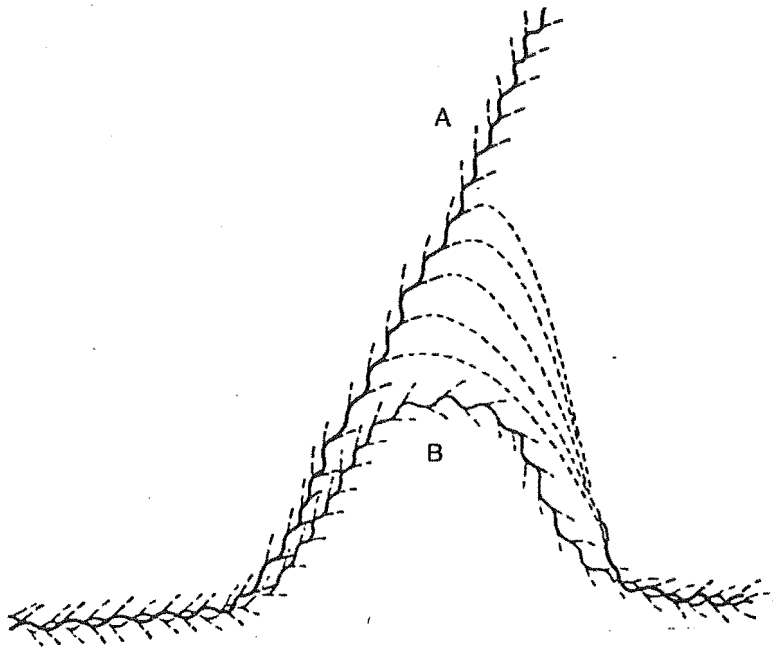
> "An overt struggle over values is becoming evident tending toward a shift in dominance between two basically different systems that have long coexisted as two parts of a conflicting dualism."

The B curve is dominated by what Salk calls the Being which corresponds, in biological terms, to the genetic code or range of possibilities for expression of human form. It represents the unconscious which is in tune with our natural surroundings (5).

The A curve is dominated by Ego - the conscious element which reacts to the outside world and mediates between Being and its environment. Ego corresponds to the somatic rather than the genetic - it is the means of expression of Being.

Being and Ego are totally interdependent - the wholeness or health of an individual is lost if Being can not be expressed or it is repressed. The integration of both is necessary for full human development, for what Salk terms 'disciplined self-expression'.

Salk explains that the A and B curves were once inter-twined but became separated over human history by the dominance of A over B.



Now, if humanity is not to be destroyed, individuals must restore that integration, such that Ego operates to serve Being - which ultimately, according to Salk, is an expression of the desire to fulfill the specie's purpose of survival. Thus the 'purpose of life' must be matched with 'purposes in life', or, in other words, ends reconciled with means.

The resolution of the prevailing conflict by competitive elimination (an 'either/or attitude') would be catastrophic. Salk hopes that, instead, a healthy complementarity may develop, a "coalescence of opposites".

He suggests that the present conflict in industrial society is a struggle between the wise and the unwise. The wise are those people who recognise the processes of nature as a continuing balance between the elements of disorder and order.

Wisdom arises when both the conscious and the unconscious are realized within the individual and they have a sense of being and becoming, an awareness of their place in the process of evolution. The survival of the species, concludes

Salk, depends upon the survival of the wisest - those who look to the laws of nature for a guide to an appropriate way of living.

3) SYNTHESIS

A growing number of writers[1] are concluding that an appropriate image for human survival must be based on a holistic understanding of the ways of Nature. Falk, for example, believes that:

> "The tendencies toward the destruction of life cannot be dealt with until there emerges a much stronger sense of wholeness and oneness, of the wholeness of the earth and the oneness of the human family" (6).

Wholeness, in contrast to a fragmentary view of reality, requires the presence of both principles - within the individual person and in the interaction between people and nature - a view which Roszak (1979) calls "Person-Planet".

Henderson (1978), referring to the work of psychologist Robert Ornstein, looks forward to a new balance within the human psyche.

According to Ornstein, the linear, sequential, quantitative, reductionist cognition is a function of the left hemisphere of the human brain. In contrast, the 'right brain' processes information in spatial, simultaneous modes and is the source of intuitive, imaginative modes of cognition. Both modes of cognition are equally important

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1. See for example Capra (1977), Henderson (1978) or Kozlovsky (1974).

- only when one dominates the other will disequilibrium occur.

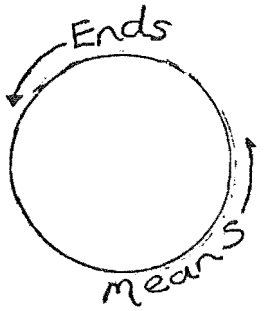
Henderson believes that "the spontaneous re-assertion of right-brain cognition, perhaps as an almost biological-level survival response, is producing new yearnings for reintegration of head and heart, mind and body, and a rich new yeast of intellectual insights" (7).

In effect, the new organic way of seeing, suggests a reintegration of the ends and means of human survival. Recalling Daly's means-ends spectrum from Chapter 1, we can see that it persists with a clearly linear and hierarchical view of reality. Daly has separated matter from spirit and placed them as opposing poles:

Religion ┼ Ultimate Ends

Economics ┼

Physics ┼ Ultimate Means



A holistic view would turn this model back upon itself, so that the line became a circle - matter and spirit the same entity but always in continually changing form. A cyclic model has no need for the fragmentary distinctions which have been arranged in the linear view. Economics is no longer the pivotal point - purpose and process are now one, *in-formed* as a unified way of knowing/being.

Such a model provides a true metaphor for the natural world - not an environment *out there* which may be entered or neglected at will, but a wonderful 'Dance of Life' which we may delight to know we are part of.

McHarg (1970) writes that from this view:

> "one can conclude that by living one is united with the origins of life. If life is originated from matter, then by living one is united with the primeval hydrogen. The earth has been the one home for all of its evolving processes and for all its inhabitants; from hydrogen to man, it is only the bathing sunlight which changes. The planet contains our origins, our history, our milieu - it is our home" (8).

4. CONCLUSION

The organic paradigm represents a very new way of viewing reality and yet, at the same time, it is a return to much of the 'ancient wisdom'[2] of human societies.

The development of industrialism is a very recent event in the history of human development but it has produced a level of social and environmental disorder which potentially threatens all life on the planet.

This crisis has generated a number of deepening contradictions within the technocratic paradigm which have summoned together a new way of knowing and being in the world. The organic paradigm seeks to reconcile the conflict

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2. This is a term used by Schumacher (1973).

between the means and ends of human survival and is based on a holistic view of reality - an ancient view which has been suppressed and lost within the western tradition.

Jung, in his work *Man and his Symbols*, explains that unlike the Eastern tradition, the West has become devoid of the symbolism, expressed through the unconscious, which connects the individual to other human beings and to the cosmos.

The symbol of wholeness in other traditions is the Mandala - a circular structure (perhaps a symbolic representation of the nuclear atom) used "to restore a lost inner balance". Through contemplation of this symbol the individual is able to gain "an inner peace, a feeling that life has again found its meaning and order" (9).

However, the suppression of wholeness in the West (in the pursuit of continuing technological expansion) may now have reached a point where Nature is turning against Industrial Man and his technocratic mind. Jung believes that the image of the twentieth century is an atomic explosion - a symbol for the exact opposite of wholeness: complete physical disorder and destruction, and a complete psychological dissociation or madness (10).

The dialectic of a transition to a steady state involves a fundamental evolutionary choice - between a world view which perpetuates the prevailing trend towards perfect technique and perfect annihilation, or a new way of knowing

and being in the world which accepts the discipline of environmental constraints and through which Technological Man may come to live, as a human being.

Schumacher (1980) writes that:

> "As more and more people realize the predicament of modern technological society and the dangers it is facing, I can see the formation of a new battleline. On the one side, there will be what we might call the people of the forward stampede, with the slogan: 'A break-through a day keeps the crisis at bay'. On the other side there will be - What shall we call them? - the home comers: people striving to lead things back to their proper place and function ... [who] believe that the spiritual has dominion over the material, which it is called upon to use *just so far* as it is needed for the attainment of spiritual ends, and no further" (emphasis in original) (11).

Gray (1978) considers herself as one of the 'home comers', people who "yearn to be 'at home' - with ourselves, at home with another, at home with our world and our shared destinies that lead us through joys and pains and finally to our dying" (12).

But she warns that such visions are likely to be subjected to the traditional Genesis myth of the Fall and the criticism that a harmonious life only ever existed "in some never-never land":

> "... to aspire to 'being at home' with one's world, one's neighbours, one's self, is to evoke (from oneself as well as from others) the quashing epithet of Utopian or Romantic or hopelessly idealistic" (13).

Gray concludes that we must re-myth Genesis - turn it upon its head and accept that "this finite planet and the here and now is our Eden" and we should rejoice to be part of the Creation (14).

Gray's vivacity and her arguments are certainly appealing but must be measured against the opposing forces at work (and usually in charge) in industrial society. The only certainty is that the battle between the world views of growth and equilibrium will inevitably escalate. And that Nature will make the final evolutionary choices.

CONCLUSION

In the preceding chapters I have suggested that the global environmental crisis of depletion, pollution and over-population represents an anomaly within the technocratic paradigm which is increasingly unsolvable.

The crisis has revealed a number of deep contradictions from which is emerging a new organic paradigm. This world view rejects the essentially masculine values of growth and progress and involves a more feminine way of knowing and being in the world. It emphasises wholeness rather than fragmentation, and seeks to reconcile the means and the ends of human existence. The organic paradigm accepts the natural cyclic processes of life and death and it recognises that within a finite earth spiritual growth should be valued over material accumulation.

The emergence of the organic paradigm can be seen as part of a natural process in itself.

For example, Robertson (1978) writes that "the idea of the breakdown of an old way of life and a breakthrough to a new one suggests a parallel with the decline of the old and the growth of the new in nature's cycles: death and birth; evening and morning; winter and spring" (1).

The confusion and disorder of the modern world can perhaps be regarded in a more optimistic light if we accept the view of Seaborg (1970):

> "What we are seeing today in our social upheavals in all our alarm and anguish over environmental feedback and, in general, the apparent piling of crisis upon crisis to an almost intolerable degree, is not a forecast of doom. It is the birth pangs of a new world ..." (2).

Similarly, Forrester (1973) reassures us that these stresses arise from the pressures that always accompany the transition from growth to equilibrium. Thus, as Henderson (1978) explains:

> "All biological systems, including human societies ... involve continuous cycles of entropy and synergy: the breaking down and the building up of structure and the constant recycling of detritus that releases the nutrients for new growth, synthesis and evolution" (13).

The next stage in human evolution is developing from a cybernetic response of individuals within industrial society to the breakdown around them. This physical change is generating a new set of information, or way of knowing about reality, which will in turn generate new forms of social behaviour or form - new ways of being in the world.

It is easy to dismiss proponents of the new paradigm as utopian and 'out of touch' with what is possible in the world. However, as Knelman (1978) notes:

> "all revolutions begin in time and space with impossible conditions for success .... [But] it seems a characteristic of all great social revolutions that they develop from streams of convergence or lines of resonance where small effects multiply, converge and resonate until a great qualitative change results and a new wave is created. The conditions for necessary change now exist and are ripe and seeking the means of their fulfilment" (4).

This dynamic is clearly recognised by one of the more astute observers of industrial society, Marshall McLuhan, who says that every kind of cultural artefact (words, theories, philosophies, laws) has a structure which is a, b, c, d. One has to ask: What does it enhance? What does it obsolesce? What does it bring back which had been obsolesced earlier and what does it 'flip into' when pressed to the extreme? "When any particular form of activity reaches its term of potential it flips into the opposite form. It shows the exaggerated features of the old forms just before they cease to exist" (5).

In this section I have attempted to demonstrate that this process is occurring within the technocratic paradigm which grounds industrial society. Now that industrialism has exceeded the terms of its potential, an opposing form is emerging which provides a new evolutionary choice - the new world view or self image of a steady state society.

The cultural evolution of a society cannot be understood apart from its physical evolution - social paradigms and social structures are inherently a response to ecological conditions and, therefore, must adjust when those conditions no longer prevail. Glacken (1967), for example, finds that the history of an idea can be related to the history of a culture; both make changes and innovations, "accepting this, rejecting that, abandoning something as useless or obsolescent, retaining something held dear, each new synthesis preparing its own opportunities for further change, retention or innovation" (6).

This process occurs as a continuous evolutionary dynamic - an on-going interaction between culture and nature. It can be seen as an endless exchange as culture reacts to its surroundings and so defines itself; a dialogue with nature from which form and meaning are generated.

It is possible to view this process from a number of perspectives; to see it as a cybernetic response of the human system to changing environmental conditions, a thermodynamic cycle of entropy and synergy, an ecological transition from growth to equilibrium, the resolution of anomalies through a paradigm crisis or the birth of a new synthesis from the dialectical conflict of opposites.

However, none of these explanations provides a genuinely holistic understanding. Many can only be made with highly technocratic (mechanical, quantitative) language and each comes to speak with the world from a different place - such are the highly fragmented sources of Western knowledge.

For a truly holistic world view there would be no such divisions and, indeed, no need to speak of 'world views' and 'environmental conditions' and 'social forms' - for these would be one, and so could not be distinguished.

This way of understanding is beautifully expressed in the writings of the ancient Chinese philosopher, Lao Tsu:

The Tao is never undefined.
Small though it is in the unformed state, it
cannot be grasped.
If kings and lords could harness it,
The ten thousand things would naturally obey.
Heaven and Earth would come together
And gentle rain fall.
Men would need no more instruction
and all things would take their course.

Once the world is divided, the parts need names.
There are already enough names.
One must know when to stop.
Knowing when to stop avoids trouble.
Tao in the world is like a river flowing home
to the sea.

However, I do not believe it is possible for the West to successfully recapture the philosophy of the East, to take on a world view borrowed from another time in the hope of ecological salvation. What is possible, and indeed inevitable, is that people in industrial society relinquish the world view which has led them beyond success into the environmental crisis.

Once a choice is made to work for a deliberate transition to a steady state, a new world view will already have been born.

PART III RESOURCE MANAGEMENT AND THE TRANSITION TO A STEADY STATE

Chapter 8. RESOURCE MANAGEMENT IN TRANSITION

RESOURCE MANAGEMENT IN TRANSITION

1) INTRODUCTION

In this final chapter trends in Resource Management are shown to reflect the same processes occurring in wider industrial society.

There is a deepening conflict between economic values of growth and control, and the constraints of environmental limits.

From this has emerged an ecological world view in which both technocratic and organic trends are discernible - the first toward greater efficiency in the management of the human environment, based on sophisticated systems theory and thermodynamic analysis, and a second trend toward a more organic view of Nature, emphasising humility and frugality.

These divergent views can be characterized by what Miller (1975) calls a Spaceship Earth as opposed to an Earthmanship image. This distinction underlies the choice between a steady state society based on the "Maximum Feasible" rate of energy use (resource conversion), or a low-energy, "Frugal" society (1).

2) THE TECHNIQUE OF MANAGEMENT

As human activities have come to exceed the limits of the earth's ecosystems, an 'environmental crisis' has

developed, a global predicament of depletion, pollution and over population. After nearly four hundred years of human expansion (through new discoveries, new technologies) it seems to Industrial Man that Nature has suddenly become perverse and hostile - refusing to supply the raw materials that he needs or to absorb his wastes. Man's reaction to the backlash of disorder that threatens to disrupt his economic progress has been to take hold of 'environmental problems' and to divert energy into controlling them.

This response is inherently economic. Nature is perceived of in terms of 'resources' - those bits of reality which become visible when, through the convergence of technological, scientific and economic forces, they are found to be useful. Parts of Nature can be given a value because they can be taken and used in the production process. Similarly, other parts are accorded value when it becomes clear that they perform economic services, such as the provision of fresh water, fertile soil and clean air.

Thus Nature is reduced to 'environment' - a physical system adjacent to the social system which is useful for 'inputs' and 'outputs'. Nature is divided into units of use for agriculture, recreation, scientific knowledge, scenery or industrial materials.

Moreover society itself is reduced to an economic system. The 'human environment' is divided into public and

private spheres and people are regarded as 'human resources' which can both produce items of value (television sets, recreation reserves, foodstuffs, houses, cars, information) and consume them. People are known by what they do, i.e. which 'industry' they belong to (entertainment industry, dairy industry, building industry, retailing industry or even the kiwifruit industry) and are labelled according to their sector (Home maker, Manufacturer, Worker, Scientist).

Thus both nature and people are reduced to what Arnoux (1978) calls "signs" which indicate how they can be used and exchanged:

> "The process of economics is to reduce all objects to a single dimension. ... [It] corresponds to the translation in numerical terms of a social order. It is the reduction of people and things to a single scale, the structural law of value." (2)

As a result, society becomes an "autonomous system where everything and everybody tends to be reduced to signs and all are interchangeable in an endless series of combinations and computations". This process ignores their practical, physical properties, their emotive subjective aspects or symbolic meaning and reduces them to a code of value.

So with Nature:

> "a piece of our world, our reality, is carved out, labelled 'environment'; it is then assessed, measured, stored (e.g. in National Parks), considered as an asset, traded off against other pieces of the same world and so on." (3).

Arnoux stresses that this approach is historically new; "it is only found in modern society".

When Nature ceases to yield services to Man the environment is labelled as a 'problem' and must be 'managed'. Each problem - air pollution, erosion, fisheries depletion, urban refuse, wildlife conservation - is treated as an isolated entity, and the same fragmentation occurs in the application of the corresponding management techniques, which can be economic, legal, technological, sociological or a combination of controls.

In his analysis of recent energy resource development controversies in New Zealand, O'Connor (1981) finds that management techniques are being used in an attempt to achieve an (illusory) 'Balance' whereby conflicting demands for resource use can be resolved.

Environmental resources (dammable rivers, wildlife, mountain scenery, species of scientific importance) are used by a number of competing interest groups (hydro-industrializer fishermen, canoeists, trampers, photographers, biologists) but when they are in short supply conflicts emerge.

Thus managers must undertake a cost-benefit analysis to see which use produces the highest value (the greatest benefit to the greatest number) for the least costs (opportunity for use foregone) or in other words, is the most 'profitable'.

Of course, use value is measured in predominantly economic terms and those uses which cannot be easily quantified are relegated to the status of 'intangibles'.

However, in response to criticism that resource use decisions are weighted too heavily in favour of developers, management is now trying to take the 'Other' factors into account. The equation is now widened to include 'social impacts' on community, aesthetic, historic or ethnic values, and 'ecological impacts' on species diversity, synergetic effects and long term implications.

Thus when all of these factors have been taken account of and incorporated into the decision making process, it is declared that a 'balance' has been achieved and so the environmental problem has been 'solved'. In this way, the 'environmental crisis' has been reduced to a series of crises or problems which are subsequently defined in terms of management goals such as 'balance' or 'best use'. Therefore, as O'Connor remarks, the 'problem' becomes 'problem-solving'; the perfection of the means of management technique is an end in itself.

In effect, the anomaly of the 'environmental crisis' is declared resolved within the 'puzzle-solving' framework of management. Any inconsistencies which exist are rendered invisible (for example the persistence of widening income gaps in the face of the theory of 'trickle-down' and multiplier effects). Occasionally other contradictions rise up to challenge the prevailing management ethos: "You

have forgotten the .... impact" (substitute 'local', 'archaelogical', 'long term', 'psychological' etc). They too are labelled and plugged into the decision-making machine.

Often the challenge is made that management decisions have failed to take enough information into account and so management seeks to expand its data base. This expansion occurs through the 'hardware' of computer technology, satellite imagery or pollution measuring devices, and 'software' like institutional arrangements ('watchdog' agencies, social surveys, public participation) and theoretical techniques (energy analysis, thermodynamic performance, resource economics).

The result is a Total Planning System which seeks to make 'rational decisions' based on a 'comprehensive analysis' of all the factors to produce 'efficient' and 'objective' solutions. This has generated a trend within management oriented towards the 'perfect control' of all variables - a global planning system in which decision makers have information about environmental conditions anywhere in the world at their fingertips and can switch 'corrective procedures' into operation.(4)

Thus the Super Planner can achieve an 'eye-of-God' view of the world - a view not dissimilar to the view from the cockpit of a Spaceship, a perfect machine of flashing warnings, humming controls, a veritable flight deck of cybernetic order (with perhaps an occasional glance out the port-hole to see if the beautiful green planet is still there)

But, as we have seen in earlier chapters, the objective of 'perfect control' is an illusion. Technological Man is fallible, he can not avoid making 'human errors', he can not eliminate uncertainty, the 'fickleness' of Nature.

Moreover in his attempts to achieve perfect order through perfect technique he only produces greater disorder. The more he 'tightens the screws' the greater the thermodynamic repercussions. This sets up a positive feedback of increasing control and disorder, a "cascade" (5) of problems and management solutions which only generate more problems.

The paradox of balance in planning is that by taking all factors into account[1] the level of resource use (demand) is expanded rather than controlled. By concentrating on the means of relieving the symptoms of growth, planning serves only to perpetuate it. Thus, as Meadows (1973) observes, the response to jammed highways is to build more highways; if copper reserves are depleted, import more copper; if electricity is insufficient, build more power stations; if soil is depleted, buy more fertilizers. Illich (1973) finds that:

> "it has become fashionable to say that where science and technology have created problems, it is only more scientific understanding and better technology that can carry us past them. The cure for bad management is more management. The cure for specialized research is more costly, inter-disciplinary research, just as the cure for

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1. This is the aim of multiple use or multiple objective planning.

> polluted rivers is more costly, non-polluting detergents. The pooling of stores of information, the building up of the knowledge stock, the attempt to overwhelm present problems by the production of more science is the ultimate attempt to solve a crisis by escalation" (6).

According to Rodin (1981) the fragmentation of environment into crises has produced a response of fragmented controls:

> "Thus, ironically, the proposed solutions to crises and the integration of various fragments within systematic planning procedures, far from resolving the crises, only create new and yet more complex crises" (7).

This response reflects the true nature of the environmental crisis which is "the underlying crisis of our world view, our technical form of life which breaks up the totality of what is into a multiplicity of warring fragments" (8). Rodin finds this fragmentation is grounded in the atomistic world view implicit in the (mechanical) language of technique that rules modern life:

> "In our sense of separation, of estrangement from our natural environment, from our social structures, from each other, from ourselves, from our knowledge and from our language, we display the essential crisis of our alienated being in language and life." (9).

The technocratic response to the problem of fragmentation and alienation is to control the 'human factor'. For example, Caldwell (1971) writes that the most important meaning of environmental administration is the control of human action, "it is not the environment that is managed but rather people". (10):

> "Environmental administration is largely the management of men in relation to their environment, and therefore the tendencies of men and the beliefs that motivate them are of practical relevance to the administrative process." (11)

The most effective way for managers to "obtain environmental objectives is often to internalize behaviour patterns" in people. Pirages (1977) assures us that:

> "It is now possible to design a sustainable society that can persist through the period of economic transition that will soon be upon us. ... Socialization processes are well understood and methods by which attitudes can be changed are known and employed every day by Madison Avenue." (12)

For Pirages,the design task is one of devising both institutions and strategies for a transition to "sustainable growth". It involves "uprooting a firmly entrenched dominant social paradigm and replacing it with one that fosters sustainable expectations in the long term". And he warns:

> "The magnitude of this task is tremendous and should not be underestimated." (13)

In this last respect, Pirages is entirely correct. To achieve such a splendidly ordered society would require vast amounts of energy (both physical and political power) and, to hold such an entity together, even more control would be needed to arrest any outbreaks of disorder.

By proposing such a design, management technique seeks to internalize the final anomaly - the control of human irregularity in the administration of the Man-Environment system.

But as with all the other devices of technique this final control can only lead to greater disorder. Pirage's comments suggest three sources of repercussion. First of all, one must ask who is doing the controlling and the designing of human behaviour?[2] All of human history shows that under a repressive regime, the anger and resentment of people builds up and will frequently erupt in violence. As O'Connor (1981) remarks, "violence breeds violence, and the tighter the attempted repression, the greater the pressure for revolt. This pressure is the same in political revolt as in ecological catastrophe ..." (14).

Secondly, a super-planned society would be intolerable to live in. Mumford (1970) believes that it would result in:

> "the replacement of the natural and human habitat, which is extremely complex, with a simplified, uniform, overcontrolled technological environment in which only equally simplified and underdimensioned human beings will be capable of existing" (15).

As we saw in Chapter 5, this degree of technocratic perfection can only be achieved by repressing the human qualities in people, by denying the symbolic aspects of life and rendering it meaningless.

Finally, the technique of management must be rejected

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2. Pirages asserts that his concept is not 'Orwellian', that authority relationships need not be changed so long as those in power have a realistic vision of ecological reality and are altruistic. I find this rather naive.

because the ideology of control itself produces disorder. All the experts who would design a solution to the environmental crisis by institutionalizing "sustainable growth" are perpetuating a farce. This illusion is promulgated in concepts such as 'balanced', 'low', 'regulated' or 'steady growth' (16). It is found in a report to President Nixon (1971) from his National Goals Research Staff entitled "Toward Balanced Growth: Quantity with Quality" (17). In New Zealand we have a "Conservation Strategy" which aims to 'integrate conservation and development'. The myth that 'development' can be 'sustainable' is an attempt to have the resource pie and to eat it, while refusing to recognise, as Illich (1973) remarks, that it is 'pie in the sky'.

Such technique avoids the fundamental issue that infinite growth in a finite world is not possible. That increasing growth, energy use, order, information and control can only deepen the environmental crisis.

In summary, it is worth referring to the words of Lewis Mumford:

> "The basic assumption behind modern technology is that organic functions, human purposes and cultural values must be reduced to their lowest factor and brought under control. Whose control? The control of the people who are in charge of the technical process. Not a control achieved by a consensus of mankind or by reference to the accumulated values of human history.
>
> If you are interested in redeeming the human habitat you must deal with this pathological technical syndrome - one which exhibits a barely

> concealed hostility to living organisms, vital functions, organic associations.
>
> [It] is based on a desire to displace the organic with the synthetic and prefabricated, the scientifically controlled, and to rule out every aspect of life which isn't amenable to this process. ... We are organizing our activities on a totalitarian, mechanical pattern ... the natural and humanized habitat becomes physically unusable or psychologically invisible.
>
> The technological environment is a one way system, there is no conversation with the environment.
>
> Wipe out nature, wipe out human purposes, memories and expectancies and the real world disappears.
>
> The result of loss of contact with the real world is insanity." (18)

3) HOLISM AND BEING AT HOME

The rejection of economic and technocratic approaches in resource management occurs with the recognition of the contradictions and repercussions these controls are generating.

Along with other disciplines, management could be seen to be in crisis - it can not achieve its goal of 'balance' while it continues to internalize environmental puzzles within the dominant framework of increasing order.

However, as Rodin (1981) reminds us, the Greek root of 'crisis' is Krisis - to reach a turning point or make a decision. Within resource management such a point has been reached with the advent of ecology. In contrast to conventional reductionist and fragmentary disciplines, ecology is a

science which seeks to understand the connections between parts, to draw them together as a whole, an interacting organic unity.

Increasingly, resource planning is confronted with ecological concepts which challenge the technique of management. For example, Watt *et al.* (1977) point to the following characteristics:

1) A view that Man is part of Nature and can not regard himself as unique or superior to other creatures on the planet, for we all have the same organic origins in evolution.

2) A view of society as an integrated system (rather than a series of sectors) of integrated behaviours and patterns which can not be understood or predicted by dealing with one or several parts.

3) A recognition that like other populations, the human system goes through stages of growth and will reach a no growth or steady state, emphasising quality rather than quantity, low energy use and stability. Thus 'progress' is cyclic not linear, civilizations will always be limited by space, resources, time and knowledge.

4) A view that in a steady state moral advancement rather than material affluence is the goal.

5) That, as with other species, bigness is not always better, it can become excessive and harmful, increasing the degree of organised matter in the world and so entropic. That it is inimical to diversity and dehumanizes people.

However, even these images of ecological limits and the wholeness of ecosystems can take on a technocratic character. Increasing knowledge about the way ecosystems work tends to invite an increase in the technique of describing them - a proliferation of mathematical analyses which can become grist for the mill of Total Planning.

Knowledge about ecosystems can also prove an attraction to the manipulative super-planner. For example Odum (1971), oblivious of the repercussions of misguided interference, believes that:

> "exciting possibilities for great future progress lie in manipulating natural systems into entirely new designs for the good of man and nature. The inventory of the species of the earth is really an immense bin of parts available to the ecological engineer". (19)

This use of ecological insights makes possible what Ophuls (1977) describes as a Maximum Feasible version of a steady state, in which nature can be 'rationally exploited' using mathematical techniques such as maximum sustained yield. Human resource demand is maintained at maximum environmental carrying capacity - which must be quantitatively assessed and under constant surveillance. This view aims to "squeeze out the maximum value of nature with a relatively high throughput economy" i.e. to do what Man is doing now but "more intelligently from an ecological point of view".

Once again Man is attempting (in the words of a recent advertisement to face today's realities without 'cramping his style'. Thus we have returned to a spaceship image of the world, as demonstrated by Caldwell (1971) who writes about:

> "a unified system dependent upon the *co-ordinated* and continued *functioning* of inter-relating systems and *parts*. It has *surpluses, redundancy* and *back up capacity*, but its *resources* are nevertheless limited. Because carrying capacity is one of its limits, it must so far as possible recycle all its resources unless it can obtain them at a *feasible cost* from *external sources*. Changes in the system must be studied in relation to their *total effects*, because altered relationships among the parts, even intended *improvements*, may adversely affect the *performance* of the whole. Maintenance of the system and its subsystems must be *watched*, for failure at any critical point could lead to the destruction of the entire *enterprise*" (20) (emphasis added).

Caldwell calls this a 'holistic' or 'comprehensive' view of environmental relationships. The objective of this planning approach is:

> "to design the dimensions of the comprehensive tasks of environmental administration so as to make them manageable (i.e. comprehensible) - to guide the operating programme so that they are effective and do not counteract one another --- [and] to avoid the dangers of inadvertant drift which may carry a programme away from its intended purposes. ... [Thus] the holistic or integrative overview ... serves as apreventative or a corrective function".(21)

However, Miller (1975) insists that the spaceship metaphor is an upside down view of reality which turns the biosphere into a rigidly controlled machine and implies that there is always somewhere it can 'take on new supplies'. It is a patently *pseudo-holistic* view in which man thinks he can preserve 'his ship' by controlling everything.(22) Similarly, White (1976) concludes:

> "A spaceship is a human artifact, designed to sustain human life and no other purpose. ... The spaceship mentality is the final

> sophistication of this disastrous man-centred view of the nature of things and the things of nature, and it has the present allurement of seeming to offer ecological solutions without sacrifice of the old presuppositions" (23).

In contrast, Miller offers an 'Earthmanship' view based on "harmonious collaboration with nature, in selective control based on ecological understanding and an ethic of creative earth stewardship":

> "Because we can never know how everything or even most things are interconnected, true holism involves restraint and humility." (24)

Thus, while Miller retains much of the 'cosmological pyramid' in his image of Ecological Man (the wise Steward of Nature), his break from technocratic thinking is an important one. I would like to think that ecology does have the potential to develop a sense of oneness with Nature, which need not degenerate into technological arrogance and self-defeat.

Indeed there are indications that a rejection of super-ecological-planning is occurring. For example, Holling (1973), in criticism of the sustained yield technique, suggests a management approach:

> "based on resilience [which] would emphasize the need to keep options open, the need to view events in a regional rather than a local context and the need to emphasise heterogeneity. Flowing from this would not be the presumption of sufficient knowledge but the recognition of our ignorance; not the assumption that future events are expected but that they will be unexpected" (25).

The resilient framework, says Holling, does not require a precise capacity to predict the future but only a "qualitative capacity" to absorb future events.

Holling's thinking suggests a move away from operating rigidly at the margin of ecological carrying capacity. (26) For industrial society, such a move would involve a decrease in order and control, a reduction in energy use and the development of low-energy technologies and social organisation.

Ophuls (1977) has described this as a Frugal version of the steady state, which would make a sharp break with the principles of the modern era and would be characterised by:

- a lower throughput economy based on optimal (rather than maximum) resource use;
- decentralisation, a simple and smaller scale of life, and 'face to face' relationships;
- labour intensive production, individual self-sufficiency (rather than dependence on a [centralized] complex economy);
- cultural diversity and local community politics;
- a de-emphasis on material things. (27)

The Frugal state offers a counterpoint to the two aspects of the environmental crisis outlined in Chapter 1.

It is about *using less energy* and approaching Nature with *humility*, rather than seeking to 'conquer' her.

Ecology contains the seeds of a new world view which faces up to the realities of a finite earth, which

reveals our connections and responsibilities toward other living things[3] and which makes plain the consequences of desacrilizing the earthly home in the pursuit of technological glory.

Such a view would make it possible for Man to be be content with 'being at home' in the world, rather than launching off to re-order it. And of learning how best to 'be' in it through learning a sense of place.

3) CONCLUSION

It is not possible at this point to predict how the conflicting trends in Resource Management may develop.

However, it may be ventured that the same dialectic potential exists as in wider society - the contradictions of growth, the fragmentation of the world (environment) and of world views (academic knowledge) and the possibility of reconciliation or Holism.

Trends in Resource Management suggest an emphasis on using less energy/control and accumulating less information. Thus, as Ophuls (1977) concludes, "the essential message of ecology is limitation: there is only so much the biosphere can take and only so much it can give" (28).

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3. And perhaps, less hierachically, sees some intrinsic worth and relation to 'non living things' (for example, the spirituality of stones or mountains which in other cultures are the embodiment of ancestors).

The emergence of a Frugal world view also represents a challenge to the place of Resource Management within Industrial society, for it unites new values with new social organisation (social information with social form) and thus reveals the fragmentation (contradiction) between elitist academic knowledge and the 'homely' experience of the other 'ordinary people' within industrial society.

It can be concluded that while extensive criticism of Technocratic Management must initially appear nihilistic (and even narcissistic!) this destructive response to the 'prevailing dominant paradigm' is a necessary phase in the creation of a new world view. These challenges hold up a mirror to the technocracy and so reveal the contradictions of its imagery. The challenge to resource planning involves confronting the ends or the ultimate purpose of management, rather than expanding the means of technique. Essentially, it demands answers about the fundamental issue of growth and the limits to human control.

The emergence of ecological thinking requires not only an integration of physical and sociological science but also a willingness to face the ethical and political implications of that union. As Wheeler (1975) observes:

> "The very notion of ecology implies both a moral obligation and a political imperative" (29).

Thus, in a time of transition, those within industrial society who can see beyond it, must also act. This is

nicely expressed by Dasmann (1976) who writes:

> "If all the more intelligent, more sensitive, more humane people were to drop out of the technocratic world, the people with dead souls who were left behind, as well as those who simply have not understood the realities of their world, might well succeed in destroying all life on earth.
>
> Everyone has a dual duty: to work, on their own if necessary, to establish a way of life which can be sustained - or has some hope for the future, and to work within the dominant culture to try and set it on a saner course." (30)

I would add that there is a further duty encumbent on those who find themselves infused with ecological insights. That is to recognise an anomaly in the accumulation of knowledge within academic and administrative elites in society and the under-valuing (denial of legitimacy or power) of the knowledge and experience of those about whom decisions are made.

A redistribution of the power 'to define reality' cannot, however be designed from above. Techniques which attempt to encourage 'public participation in decision making' accomplish nothing more than the appearance of community involvement. In general, the terms of participation are narrowly circumscribed[4] and serve to neutralize the 'demand' for greater information and involvement without conceding any genuine political power. Thus the definition of problems can be contained within the prevailing ideological structure: no-one can ask

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4. See in particular New Zealand's National Development Act, 1979.

fundamental questions about ultimate ends or ultimate means[5]. Design from above works only to perpetuate the structure of centralized controls over 'resource development', and to increase the ordering of Nature and people[6].

In contrast, the Frugal ethic insists on the legitimacy of fundamental questions - it requires a willingness to be 'subverted' by other views and to give up the technocratic images of control. Most importantly, it requires a willingness to listen to the knowledge of Other people, so that the voice of 'local experience' - the world that is a reality for the housewife, the poor, black people and those traditional cultures struggling to preserve their identity with the Great Mother - becomes the voice which is heard.

Such people have always been 'at home' - it is time for 'us' to listen to their wisdom.

> Do you think you can take over the universe and improve it?
> I do not believe it can be done.
>
> The universe is sacred.
> You cannot improve it.
> If you try to change it, you will ruin it.
> if you try to hold it, you will lose it.

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5. For example: Do you really need to use more electricity? How many dammable rivers are there left?
6. See for example the criticism by community advocate Russell Withers of the professional architects' treatment of local people and local places in Auckland (31).

In the pursuit of learning, every day something
is acquired.
In the pursuit of Tao, every day something is
dropped.

Less and less is done
Until non-action is achieved.
When nothing is done, nothing is left undone.

The world is ruled by letting things take
their course.
It cannot be ruled by interfering.

Lao Tsu

CONCLUSION

In this study I have attempted to throw some light on the connection between the world view of industrial society and the physical dilemma in which it is now placed. I have argued that as industrial society finds itself in an 'environmental crisis' it is confronted with fundamental questions about the level of its energy use and its attitudes toward Nature.

After nearly four hundred years of human expansion the Technocratic paradigm of increasing growth and control is no longer appropriate in a world of finite limits. In contrast, characteristics of an emergent Organic paradigm, which emphasises lower energy use and humility toward Nature, point to a new world view which could guide the transition from growth to a steady state. This shift may be observed in trends within Resource Management. The emergence of ecological concepts represents a turning point in the response to 'environmental problems' and potentially offers a more holistic world view than current fragmentary, economic approaches.

However, ecological insights can be used either to continue the expansion of technocratic controls over Nature and people, or they may generate a new kind of cosmology which emphasises frugality and non-violence (1).

For example, Naess (1973) makes a distinction between "shallow ecology" which is concerned only with the physical problems of pollution, depletion and the health of people in developed countries and a "deep ecology" movement which promises a new image of man in the biosphere[1] and emphasises an egalitarianism towards animals and different social groups and the importance of biological and cultural diversity. Naess stresses that this forms part of an ecological philosophy, in which priority is given to normative issues of value not just scientific facts.

Shepherd (1970) sees an even greater potential for ecological thinking. It involves a new vision across conventional disciplinary boundaries and it further implies:

> "... an exploration and openess across an inner boundary - an ego boundary - and appreciative understanding of the animal in ourselves which our heritage of Platonism, Christian morbidity, duality and mechanism have long held repellent and degrading. [As] the older counter currents - relics of pagan myth, the universal application of Christian compassion, philosophical naturalism, native romanticism and pantheism have been swept away ... we find ourselves in a deteriorating environment which breeds aggression and hostility towards ourselves and our world.
>
> Although ecology may be treated as a science, its greater and overriding wisdom is universal. That wisdom can be approached mathematically, chemically or it can be danced or told as a myth. It has been embodied in widely scattered, economically different cultures. It is manifest for example among pre-classical Greeks, in Navajo religion and social orientation, in Romantic poetry, ... Zen Buddhism, in the world view of the cult of

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1. Here it can be assumed that 'man' is used in a generic sense.

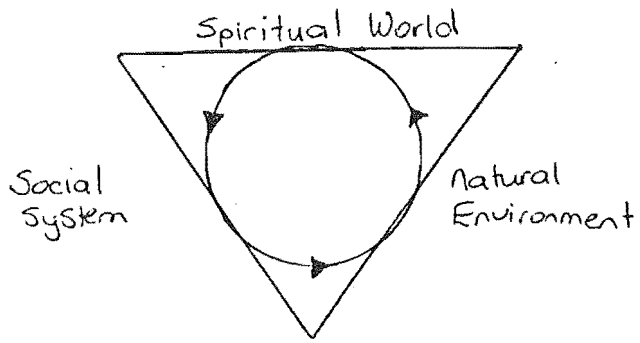
> Cretian Great Mother, in the ceremonials of Bushman hunters and in the mediaeval Christian metaphysics of light. What is common among all of them is a deep sense of engagement with the landscape, with profound connections to surroundings and to natural processes central to life" (2).

A truly holistic ecology, therefore, can bring together the physical laws governing the biosphere and philosophical questions of how people may best live, in a finite world. For example, Goodman (1980) has shown how Taoist writings reveal an understanding of natural cycles, the interconnectedness of all things, including people, and what we would call the laws of entropy.

The Taoists believed that there were "no dead spaces at the surface of the earth where elements may vanish or 'be got rid of'. Things are only moved around; sooner or later they will be back" (3).

> "The principle of one following one another, in alteration, turning back when they have reached the limit, beginning again when they have ended - these are inherent in things."
>
> Chuang Tzu

Indian anthropologist L.P. Vidarthi explains the connection between the physical and spiritual elements of a culture in terms of a Nature-Man-Spirit complex:



Dasmann(1976) concludes that "it is the relationship of people through their spiritual beliefs with the natural world "which permits them to live a sustainable life with their environment":

> "The religions are the old native religions and have nothing to do with the formal church but much to do with personal transcendence. Destroy the religion ... and the balance between humans and nature falls apart" (4).

The pragmatic response to this discussion is likely to be that such notions are all very well, but provide no practical solutions to current problems. In counterpoint, it must be realised that the social system, the natural environment and the spiritual elements connecting them, form a circular relationship, such that one cannot be drawn out without the other. For example, Disch (1970) argues that while sweeping institutional changes are needed for long term survival, in the short term there is no known way to suddenly reverse the growth of serious environmental problems. Our best hope, he says, is to minimise the impact of the worse practices and thus "buy time" until a new ecological conscience emerges. However, he concludes:

> "Whatever gains are made in finding technological solutions to ecological problems we will still fail if we cannot locate these techniques within a context of human values."

Thus, as Mumford would assert, our salvation will depend less on producing scientists and technicians and more on "producing more whole men and women at home in every part of the environment".

Therefore, it must be emphasised that "practical solutions" can be of little long term value unless at the same time philosophical issues are confronted. Indeed, as Ophuls points out, at this stage of transition:

> "any specific set of solutions would immediately be criticized as politically unrealistic. Indeed, what else could they be? Current political values and institutions are the products of the age of abundance now drawing to a close, so that solutions predicated on [ecological] scarcity would necessarily conflict with them." (5)

For Ophuls, the most important prerequisite for change is a new world view based on the realities of the human ecological predicament.

And as Disch argues:

> "In addition to the integration of ecological values into social and political systems, these changes must include the development of totally new ways of comprehending [our] place in the cosmic order." (6)

This kind of vision will encourage people to abandon an ecologically destructive lifestyle thus avoiding the need for coercive government.

These comments suggest that a centrally controlled transition need not be necessary. Henderson (1978) for example, hopes that if people could incorporate an ecological understanding into their individual consciousness "socially appropriate behaviour would be internalized without the need for external controls".

Societal checks on behaviour could also be decentralized:

> "We might recreate on a planetary scale the social sanction system of the mediaeval or tribal village where aggressive actions brought swift feedback and retribution." (7)

Disch is also optimistic that:

> "These new ways of understanding will work to restore a sense of communal involvement to diminish feelings of alienation from the non-human worlds and to heal the divisions between thought and feeling, soul and body, art and craft, religion and theology that have plagued Western man for centuries." (8)

I conclude that the emergence of a new world view is indeed the most important first step in a deliberate transition to a steady state.

However, as Ophuls warns us:

> "The frugal alternative is alien to our current way of thinking and threatens many of the material and psychological vested interests we all have in the current order, so it is quite 'unrealistic' that we shall choose simplicity and frugality except under ecological duress." (9)

Thus, the task of transition is therefore to make known the consequences of continued growth as they are emerging now, in the form of the environmental crisis.

The generation of a new way of knowing is an essentially dialectic process. It involves raising fundamental questions about the ultimate means and the ultimate ends of human existence, i.e. confronting the forbidden questions about the value of continued growth. Such a confrontation is necessarily painful - but the birth of a new world view is both a destructive and constructive process. (10)

The process of contradiction, of criticism and response, can be seen as a healthy cybernism in which the form of human behaviour can be reconciled with the information from its environment.

In essence, it requires a willingness to listen to the message of the environmental crisis, to engage in a dialogue with Nature rather than imposing a monologue of technocratic order upon her.

As Ophuls concludes, it is a matter of learning to see anew:

> "The ecological crisis is in large part a perceptual crisis; ordinary human beings simply do not see that they are part of a delicate web of life that their own actions are destroying, yet any viable solution will require them to see this. Once such a 'paradigm change' has occurred - once people have chosen to adopt ecological limitations deliberately as a consequence of their new understanding - then practical and humane solutions will be found in abundance."

The composition of this study itself has involved a dialectic process. In Part I the environmental crisis was treated as a physical problem - to be understood through the language of thermodynamics, systems theory and ecological science.

In Part II the other disciplines were relied upon to describe the crisis in historical, psychological and sociological terms.

The criticism of Resource Management in Part III was an attempt to synthesise both perspectives, and further, to suggest that a contradiction lies in the goal of

solving environmental problems by increasing control over Nature and people. The criticism is made in the belief that dialoguing and responding to contradictions is the essence of the evolutionary process and in the hope that this study may in some way be a healthy contribution to the emergence of a new world view.

NOTES

NOTES

CHAPTER 1. THE ENVIRONMENTAL CRISIS

1. Ward and Dubos, 1972. p.46.
2. Ward and Dubos, 1972. pp.46-47.
3. Knelman, 1978. p.19.
4. Commoner, 1971. p.1.
5. Illich, 1973. p.62.
6. See for example, Ehrlich 1968 and Heilbroner, 1974.
7. See for example, Kahn, 1976 and Bell, 1973.
8. O'Neill, 1976.
9. Rostow, 1960.
10. Mumford, in Disch ed., 1970. p.95.
11. Quoted in Meadows *et al.* 1972. p.69.
12. Miller, 1975. p.23.
13. Miller, 1975. p.24.
14. Martin and Wright, 1967.
15. Sears, 1953; Osborn, 1948; Sauer, 1952.
16. Miller, 1975. p.28.
17. See for example, Mishan, 1973 and Ophuls, 1977.
18. Ward and Dubos, 1972. p.46.
19. Catton, 1980; Dasmann, 1976; Falk, 1972.
20. See for example Schnaiberg, 1980.
21. Goldman, 1970. p.41.
22. Ward and Dubos, 1972. p.47.
23. Ehrlich *et al.*, 1977.
24. Miller, 1975. p.13.
25. Catton, 1980.
26. Dasmann, 1976; Goldsmith *et al.*, 1972.
27. Daly, 1980. p.361.
28. Miller, 1975. p.13; Goldsmith *et al.*, 1972.
29. Miller, 1975. p.242.
30. Catton, 1980. p.28.
31. Catton, 1980. p.29.
32. Daly, in Pirages ed., 1977. p.111.
33. Illich, 1973. p.93.
34. See for example, Daly, 1980; Georgescu-Roegen, 1971; Miller, 1975 and Pedler, 1979.
35. Ward and Dubos, 1972. p.83
36. Georgescu-Roegen in Daly ed., 1980.
37. Commoner, 1971.
38. Commoner, 1971. p.294.
39. Commoner, 1971. p.300.
40. ibid.
41. Daly, 1980. p.8.
42. Daly, 1980. p.10.
43. Hardin, in Miller, 1975.

CHAPTER 2. GROWTH IN A FINITE WORLD

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2. Bartlett, 1978. p.876.
3. Meadows, 1973.
4. Bartlett, 1978. p.877.
5. Forrester, quoted in Goldsmith *et al.*, 1972. p.17.
6. Goldsmith *et al.*, 1972. p.17.
7. Holling, 1971.
8. S.C.E.P., 1970.
9. Goldsmith *et al.*, 1972. p.16.
10. Catton, 1980. p.4.
11. Catton, 1980. p.158.
12. Henderson, 1978. p.27
13. Odum, 1972. p.183.
14. Boulding, 1966.
15. Daly, 1980.
16. Ophuls, 1977.
17. Henderson, 1978. p.4; Meadows *et al.*, 1972. p.157.
18. Miller, 1975. p.37.
19. ibid.
20. Schumacher, 1973.
21. Daly, 1980. p.16
22. Daly, 1980. p.17.
23. Catton, 1980. p.4; Meadows *et al.*, 1972. p.172.
24. Ophuls, 1977. p.133.
25. ibid.
26. Boughey, 1975. p.251 and p.254.
27. Lovelock, 1979.
28. Ophuls, 1977. p.136.
29. ibid.
30. Catton, 1980. p.7.
31. Meadows *et al.*, 1972. p.142.
32. ibid.
33. Boulding, 1961.
34. Salk, 1973. p.117.
35. Catton, 1980.
36. Meadows *et al.*, 1972. p.35.
37. Meadows *et al.*, 1972. p.156.
38. Meadows *et al.*, 1972. p.157.
39. Ogborn, 1923. p.203.
40. Ogborn, 1923. p.280.
41. Meadows *et al.*, 1972. p.183.
42. Miller, 1975. p.346.
43. Meadows *et al.*, 1972. p.144.
44. Meadows *et al.*, 1972. p.145.
45. Forrester, 1973, p.15.
46. Meadows, 1973. p.5.

CHAPTER 3. ADJUSTING TO LIMITS

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2. Commoner, 1971. p.33.
3. McNaughten and Coughenour, 1981. p.985.
4. Engelberg and Boyarsky, 1979. p.319.
5. Engelberg and Boyarsky, 1979. p.317.
6. Miller, 1975. p.77.
7. Ophuls, 1977. p.25.
8. Darwin, 1968. p.115.
9. Salk, 1973. p.4.
10. Slobodkin, 1964; quoted in Holling, 1973. p.18.
11. Ophuls, 1977. p.35.
12. Holling, 1973. p.18.
13. McNaughton and Coughenour, 1981. p.987.
14. McNaughton and Coughenour, 1981. p.989.
15. Ophuls, 1977. p.33.
16. Salk, 1973. p.12.
17. Pirages, 1978. p.259.
18. Goldsmith, 1978. p.7.
19. Goldsmith, 1978. p.33.
20. Goldsmith, 1978. p.6, p.34 and p.57.
21. Ogborn, 1923. p.271.
22. Meadows, 1973, p.3.
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24. Pirages, 1978. p.260.
25. Pirages, 1977. p.1.
26. Ophuls, in Pirages ed., 1977. pp.159-160.
27. Caldwell, 1971. p.206.
28. Catton, 1980. p.111.
29. See also Ophuls, in Pirages ed., 1977. p.160.
30. Goldsmith *et al.*, 1972. p.21.
31. Wagner, 1978. p.559.
32. Commoner, 1971. p.247.
33. Commoner, 1971. p.178; Falk, 1972. p.13.
34. Salk, 1973. p.17.
35. Salk, 1973. p.28.

PART TWO PARADIGMS IN TRANSITION

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3. Dasmann, 1976. p.403.
4. Institute of Noetic Sciences Newsletter, Vol. 9, No. 1. Quoted in Futurewatch, December 1981. p.8.
5. Ehrlich, P. and Ehrlich, A. in Daly ed., 1980. p.42.
6. Knelman, 1978. p.19.

CHAPTER 4. THE NATURE OF SOCIAL PARADIGMS

1. Pirages, 1978. p.7.
2. Ophuls, 1977. p.4
3. ibid.

CHAPTER 5. THE TECHNOCRATIC PARADIGM

1. Ellul, 1967.
2. Ehrlich, P. and Ehrlich, A. in Daly ed., 1980. p.39.
3. Meadows, 1973. p.4.
4. Institute of Noetic Sciences Newsletter, Vol. 19, No. 1. Quoted in Futurewatch, December, 1981. p.8.
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7. Glacken, 1967. p.25.
8. Glacken, 1967. p.496.
9. Glacken, 1967. p.462.
10. Glacken, 1967. p.362.
11. Glacken, 1967. p.374.
12. Gray, 1979. p.3.
13. Gray, 1979. p.4.
14. Glacken, quoted in O'Riordan, 1976. p.201.
15. Glacken, 1967. p.463.
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20. Henderson, 1978. p.16.
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22. Caldwell, 1971. p.25.
23. O'Connor, 1981.
24. Quoted in Easlea, 1980. p.274.
25. Easlea, 1980. p.220.
26. Quoted in Easlea, 1980. p.247.
27. Quoted in Easlea, 1980. p.248.
28. Quoted in Easlea, 1980. pp.247-248.
29. Drengson, 1980. p.226.
30. Drengson, 1980. p.228.
31. Ellul, 1964. p.xvi.
32. Ellul, 1964. p.xvii.
33. Ellul, 1964. p.80.
34. Ellul, 1964. p.81.
35. Ellul, 1964. p.85.
36. Ellul, 1964. pp.92-93.
37. Ellul, 1964. p.34.
38. Ellul, 1964. pp.127-128.
39. Ellul, 1964. p.134.
40. Arnoux, 1978.
41. Ellul, 1967. pp.132-133.
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57. Easlea, 1980. p.249.
58. Jung, 1964.
59. Ellul, 1964. p.139.
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CHAPTER 6. THE EMERGING ORGANIC PARADIGM

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3. ibid.
4. Bartlett, 1978. p.884.
5. Quoted in Gray 1979. p.128.
6. Knelman, 1978. p.27.
7. Schumacher, 1973.
8. Robertson (a) p.2.
9. O'Riordan, 1976. p.307.
10. Daly in Pirages ed., 1977. p.113.

CHAPTER 7. THE DIALECTIC OF TRANSITION

1. Kuhn, 1962.
2. Caldwell, 1971. p.225.
3. Quoted in Ophuls, 1977. p.x.
4. Harman, 1977.
5. See Jung, 1964. p.208.
6. Falk, 1972. p.18.
7. Henderson, 1978. p.16.
8. McHarg in Disch ed., 1970. pp.27-28.
9. Jung, 1964. p.213.
10. Jung, 1964. p.221.
11. Schumacher in Daly ed., 1980. pp.136-137.
12. Gray, 1979. p.154.
13. Gray, 1979. p.157.
14. Gray, 1979. p.158.

CONCLUSION

1. Robertson, 1978. p.117.
2. Seaborg in Miller, 1975. p.366.
3. Henderson, 1978. p.381.
4. Knelman, 1978. p.17.
5. Quoted in New Scientist, 29 January 1981. p.296.
6. Glacken, 1967. p.707.
7. Tao Te Ching, 1972.

CHAPTER 8. RESOURCE MANAGEMENT IN TRANSITION

1. Ophuls, 1977.
2. Arnoux, 1978. p.4-5.
3. ibid. p.8.
4. See for example, G.F. Kennan in Roelefs *et al.* (1974). p.265, p.267. or K.E.F. Watts *et al.* 1977.
5. O'Connor, 1981.
6. Illich, 1973. p.22.
7. Rodin, 1981. p.1.
8. ibid. p.3.
9. ibid. p.6.
10. Caldwell, 1971. p.xiii
11. ibid. p.207.
12. Pirages, 1977. p.7.
13. ibid. p.8.
14. O'Connor, 1981. p.388.
15. Mumford, Disch ed., 1977. p.96.
16. See Robertson, 1978. pp.86-87.
17. Quoted in Caldwell, 1971. p.226.
18. Mumford, in Disch ed., 1977. pp.96-98.
19. Odum, H. 1971. p.279.
20. Caldwell, 1971. p.70.
21. Caldwell, 1971. pp.58-59.
22. A further example of pseudo holismis to be found with D. Weeks (in Watt *et al.* 1977, p.19) who refers to the "entire socio-political-economic-environmental system" and whose Doctoral Dissertation (University of Hawaii, 1976) is entitled "Learning Alternative Futures: The Dominant Conceptual, Behavioural and Structural Patterns of Human Society and the Design of Polsocioeconomic Alternatives"!
23. Quoted in O'Riordan, 1976. p.102.
24. Miller, 1975. pp.368-369.
25. Holling, 1973. p.21.
26. See also R.E. Carter and D.C. Lasenby who suggest a principle of Non-Interference in Nature, i.e. acting 'lightly' in the interaction with ecosystems, with a caution based on the presumption of uncertainty.
27. Ophuls, in Pirages, ed., 1977. pp.164-166.
28. Ophuls, 1977. p.43.
29. Wheeler, in Miller, 1975. p.348.
30. Dasmann, 1976. p.419.
31. Withers, 1981. p.27.

CONCLUSION

1. See Schumacher, in Daly (ed.) 1980.
2. Shepherd, P. in Disch (ed) 1970. p.58, p.60.
3. Goodman, R. 1980. pp.74-75.
4. Dasmann, R. 1976. p.414.
5. Ophuls, 1977. p.223.
6. Disch, 1970. p.171.
7. Henderson, 1978. p.20.
8. Disch, 1970. p.172.
9. Ophuls, in Pirages (ed.) 1977. p.170.
10. Kuhn, 1962.

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